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# TELL ME WHY

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## GREAT INDIAN SCIENTISTS

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INSIDE

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Bollywood Director  
Priyadarshan releases  
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Manorama Tell Me Why,  
'Great Movies'.



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# MANORAMA TELL ME WHY

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From the house of  
MAGIC POT, THE WEEK,  
MANORAMA YEARBOOK, VANITHA &  
THE MALAYALA MANORAMA DAILY

## MEERA BHARAT MAHAAN

Twenty-six centuries ago, before the advent of modern medical practices, an Indian doctor, Sushruta stitched back the severed nose of a patient! This giant leap, considered the world's first plastic surgery, was a great milestone in medical science, since the rest of the world knew little about the human body.

India's knowledge, skill, and scientific tradition dates back to some 3000 years before Christ. Thanks to our ancestors' brilliant and creative minds, India made great achievements in different areas of science, right from introducing the concept of zero, to exploring the wonders of astronomy. The concept of the atom was first proposed by an Indian scientist, Kanada. From the microcosm to the vast expanses of outer space, nothing was beyond Indian scientific minds. Today, Indian scientists are internationally renowned, and celebrated for their innovation and talent.

This issue of Tell Me Why tells the inspiring story of our great Indian scientists, from ancient times to the present.

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# **GREAT INDIAN SCIENTISTS**

**Why is Baudhayana associated  
with the Pythagoras theorem?**

A famous theorem in geometry, known as the Pythagoras theorem was actually explained by an Indian mathematician called Baudhayana, many years before Pythagoras was born. Baudhayana lived around 800 BC. Pythagoras lived between 580 and 500 BC.

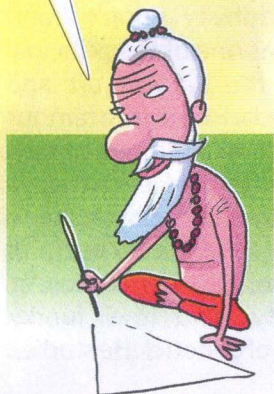
Baudhayana was the author of one of the earliest documents in Indian mathematics. It is believed that Pythagoras actually travelled to Egypt, and then India, and learned many important mathematical theories, among them what is now known as the Pythagoras theorem.

Baudhayana has made many other important discoveries. These

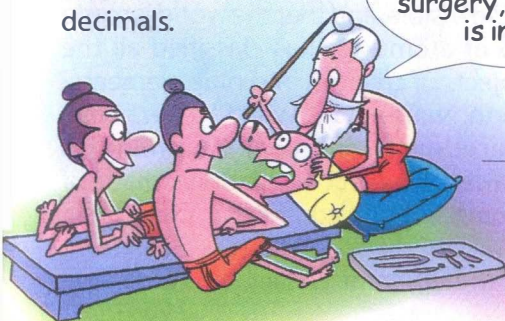
**Tell Me Why**



One day,  
a Pythagoras  
may come and  
learn this.



included how to draw a circle and a square having the same area, the value of the square root of two, and the approximate value of 'pi' which is calculated and corrected to five decimals.



Great Indian Scientists

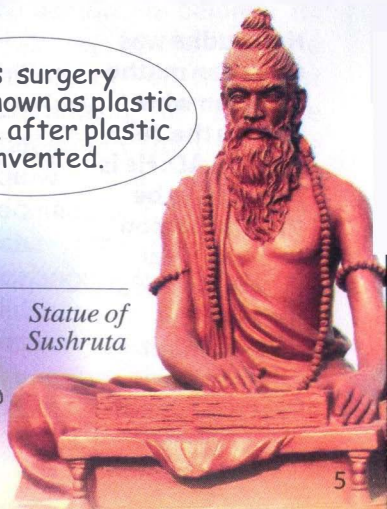
## Why is Sushruta called 'the father of plastic surgery?'

**S**ushruta was one of the earliest surgeons in recorded history. He lived in the 6<sup>th</sup> century BC, nearly 150 years before Hippocrates, and left a book, the 'Sushruta Samhita,' explaining his surgical methods.

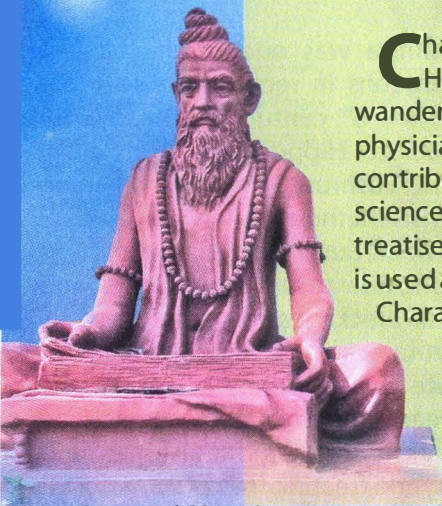
In his book, Sushruta described how to pull teeth, how to fix broken bones, and how to fix blockages of the intestines.

Sushruta was the first physician to advocate what is today known as the 'caesarean' surgery. He was also an expert in removing kidney stones, and locating and treating fractures.

Sushruta was the first physician who mended a nose almost 26 centuries ago. The technique he used is not very different from what a plastic surgeon uses today.



Statue of  
Sushruta



*Statue of Charaka*

## Why is Charaka called the 'the father of medicine'?

**C**haraka was born around 300 BC. He is believed to have been a wandering Buddhist monk and physician, and was one of the principal contributors to the ancient art and science of ayurveda. He wrote a famous treatise called 'Charaka Samhita', which is used as a reference book even today.

Charaka was the first physician to present the concept of digestion, metabolism, immunity, and the fundamentals of genetics. He studied

## Halayudha

**Halayudha was an Indian mathematician who lived in the 10<sup>th</sup> century AD. He is believed to be the first person to give a clear description of a geometrical arrangement now known as Pascal's Triangle.**

## Why is Kanada associated with the atom?

**T**he Sage Kanada, who lived in the 6<sup>th</sup> century BC, was the world's first proponent of the 'atomic theory'. He stated that the atom- or paramanu- is indivisible, and that the world is made up of atoms. He has classified all the objects of creation into nine elements- earth, water, light, wind, ether, time, space, mind, and soul. According to him, every object of creation is made of atoms. Kanada added that there are a variety of paramanu that are as different as the different classes of substances.

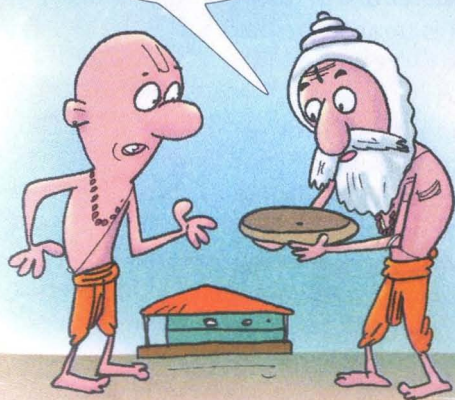


the anatomy of the human body and various organs, and calculated 360 as the total number of bones, including teeth, present in the human body. He wrongly believed that the heart had one cavity, but he was right when he considered it to be a controlling centre.

Charaka never just treated diseases. He would first study all the factors, including environment, which influence a patient's disease, and only then, prescribe a course of treatment. To this day, Charaka is called the father of medicine, and is famed for his power to illuminate the reason for illness with the lamp of knowledge and understanding.



Keep this  
'paramanu' in  
safe custody.



Each paramanu has a peculiar property which is the same as the class of substance it belongs to. Kanada spoke of the tendency of atoms or paramanu to combine together to form what we now call molecules. Kanada also put forward the idea of chemical change, which he said is caused by heat. Kanada was a genius, philosopher, and the pioneer of the atomic theory.

## Charaka Samhita

**'Charaka Samhita' is the famous Ayurvedic treatise written by Charaka. It has remained a standard work on the subject for more than two thousand years, and has been translated into many languages, including Latin and Arabic.**

### Who was Nagarjuna?

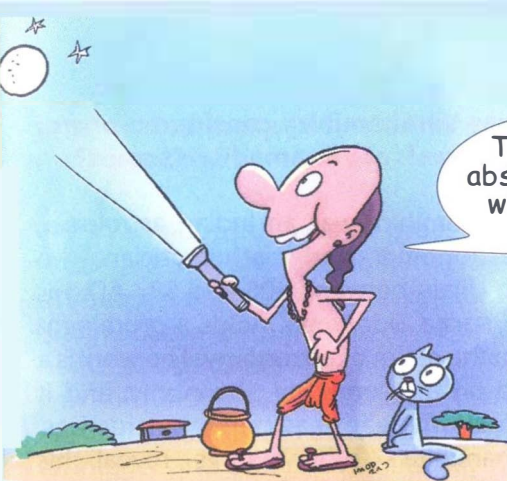
**N**agarjuna was a great Indian scientist who was born in Gujarat in AD 931. He was a chemist, an alchemist, metallurgist and medicine man.

As an alchemist, he knew the art of transmuting base metals to look like gold. The Arabs learnt the technique from him, and called it Al Kimia. Medieval Europeans learnt about it from the Arabs, and called it alchemy.

Nagarjuna's most famous work is 'Rasarat-nakara,' which deals with preparations of rasa – or mercury- compounds. In his treatise, he has discussed methods for the extraction of metals like gold, silver, tin, and copper.

As the author of medical books like 'Arogya-manjari' and 'Yogasara', he also made significant contributions to the field of curative medicine. Because of his profound scholarliness and versatile knowledge, he was appointed as chancellor of the famous University of Nalanda. He was one of the wizards of chemistry, and his discoveries continue to impress and astonish scientists even today.





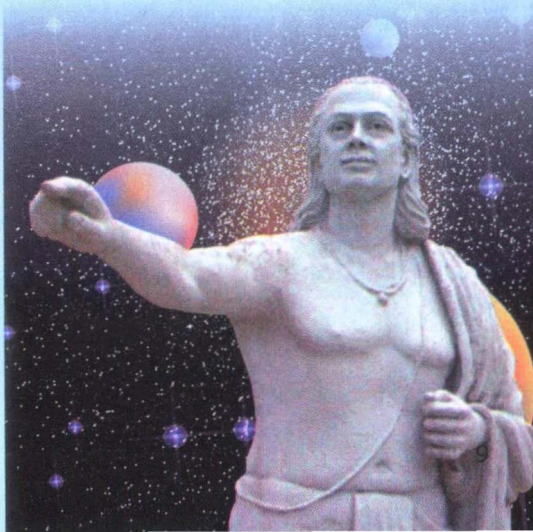
### Why is Aryabhata considered to be one of the greatest of astronomers?

**A**ryabhata is a famous Indian mathematician and astronomer, who was born in 476 AD. He studied at the University of Nalanda. Later, he became the head of the university.

Aryabhata is considered to have changed the course of mathematics and astronomy to a great extent. He was the first to deduce that the Earth is round, and that it rotates on its own axis, creating day and night. He declared that the moon is dark

and shines only because of sunlight, and that the eclipses are caused by the shadows cast by the Earth and the moon.

His most famous works are the Aryabhatiya, and the Arya Siddhanta. Aryabhata was the first in the line of great mathematician-astronomers from the classical age of Indian mathematics and astronomy. India's first satellite is named after him.



*Statue of Aryabhata*

Varahamihira



## Why was Varahamihira considered one of the nine jewels of Vikramaditya's court?

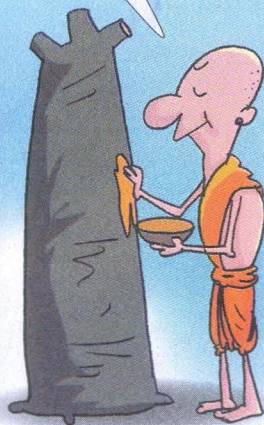
**V**arahamihira was an Indian astrologer, astronomer, and mathematician who lived in Ujjain between 505 and 587 AD. His book 'Pancha Siddhanta' holds a prominent place in the realm of astronomy. The work is a treatise on mathematical astronomy, and it summarizes five earlier astronomical treatises.

Varahamihira's other works reveal his discoveries in the fields of geography, science, botany, and animal science.

In his treatise on botanical science, Varahamihira presents cures for various diseases afflicting plants and trees. His work 'Brihat Samhita' gives us descriptions of heavenly bodies, their movements, and conjunctions.

Varahamihira made some important mathematical discoveries as well. He was considered to be one of the nine jewels or navaratnas of the court of the legendary ruler Vikramaditya of Ujjain for his contributions to different branches of science.

This medicine will heal all your wounds.





## Why is Brahmagupta considered a great mathematician?

**B**rahmagupta was a great 7<sup>th</sup> century (AD 597-668) Indian mathematician and astronomer hailing from the state of Rajasthan. Brahmagupta became the head of the astronomical observatory at Ujjain.

In his work on arithmetic, Brahmagupta explained how to find the cube and cube-root of an integer, and gave rules facilitating the computation of squares and square roots. He also gave rules for dealing with five types of combinations of fractions.

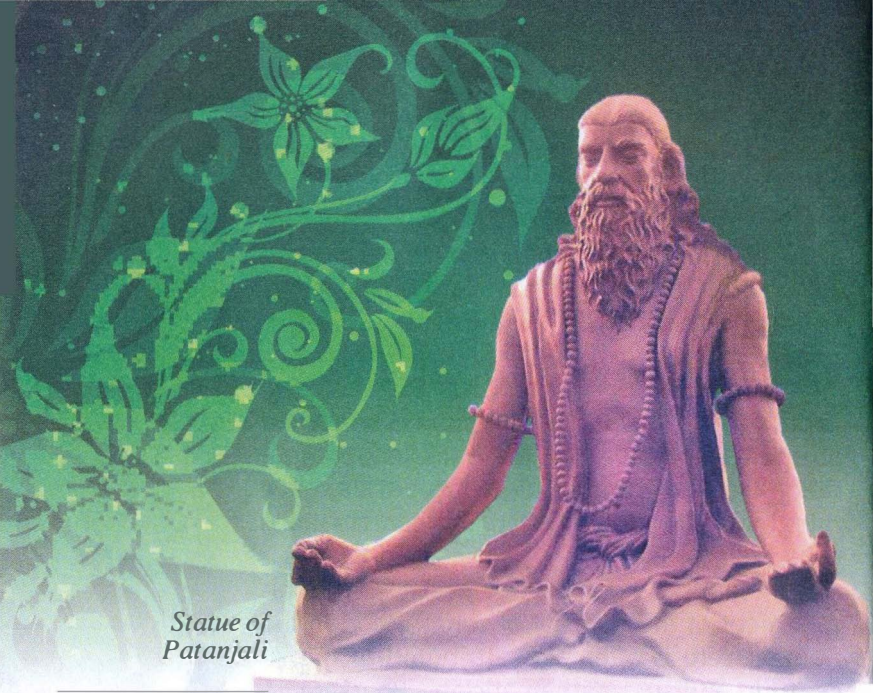
Brahmagupta's genius, however, came in his treatment of the concept of zero. Although the number zero is often also attributed to the 7<sup>th</sup> century Indian mathematician Bhaskara I,

Brahmagupta's 'Brahma Sphuta Siddhanta' is probably the earliest known text to treat zero as a number in its own right, rather than as simply a placeholder digit as was done till then.

Brahmagupta also dedicated a substantial portion of his work to geometry and trigonometry.

Geometry  
will solve all my  
problems.





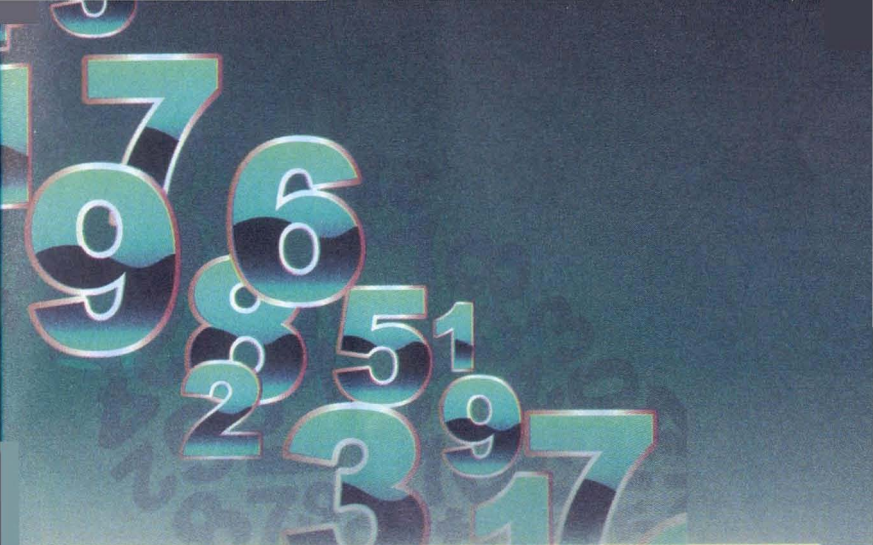
*Statue of  
Patanjali*

### **Why is Patanjali respected to this day?**

**P**atanjali, or Acharya Patanjali as he has been known through the ages, was one of the great yogis of all time. He lived in the 2<sup>nd</sup> century BC, and is credited with the first attempt to bring together all the knowledge contained in the ancient Indian science of yoga. He prescribed the control of prana or life breath as the means to control the body, mind, and soul. Acharya Patanjali's 84 yogic postures effectively enhance the efficiency of the respiratory, circulatory, nervous, digestive, and endocrine systems, and many other organs of the body.

The yoga system of Patanjali is known as the Eightfold Path, which leads to the final goal of God-realization. Acharya Patanjali will forever be remembered and revered as a pioneer in the science of self-discipline, happiness, and self-realization.

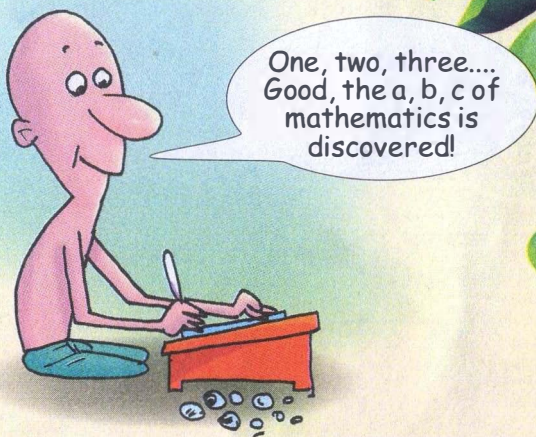




## Why is Sridhara considered to be a great mathematician?

**S**ridhara, was an Indian mathematician who lived around the 10<sup>th</sup> century (AD 870-930). There are two theories concerning his birthplace. Some historians put Bengal as the place of his birth, while other historians believe that Sridhara was born in southern India. He is famous for his writings on the practical applications of algebra, and he was one of the first to give a formula for solving quadratic equations.

Sridhara is known as the author of two mathematical treatises, namely the Trisatika, sometimes called the Patiganitasara, and the Patiganita. However, at least three other works have been attributed to him too. The Patiganita covers the mathematical operations of addition, subtraction, multiplication, division, finding squares, cubes and their roots, fractions, proportions, and some geometrical principles, but the last section is lost. The Trisatika is a brief summary of the Patiganita.



### **What are Mahavira's contributions to mathematics?**

**M**ahavira was an Indian mathematician who lived in the 9<sup>th</sup> century. He worked in Mysore in southern India, where he was a member of a school of mathematics. Mahavira made significant contributions to the development of algebra.

The only known book by Mahavira is 'Ganita Sara Samgraha,' dated 850 AD. It consisted of nine chapters, and included all the mathematical knowledge of 9<sup>th</sup> century India.

There were many Indian mathematicians before the time of Mahavira but perhaps, surprisingly, their work on mathematics is always contained in texts which discuss other topics such as astronomy.

The Ganita Sara Samgraha by Mahavira is the earliest Indian text we possess, which is devoted entirely to mathematics. Mahavira also stressed the importance of mathematics in all kinds of disciplines, including cooking.



## Why is Brahmadeva considered one of the immortals of mathematics?

**B**rahmadeva was an Indian mathematician who wrote a commentary on the work of Aryabhata. He lived between 1060 and 1130 AD in the Mathura district of Uttar Pradesh.

Brahmadeva's commentary is in nine chapters, and it follows the contents of the original work of Aryabhata, including the longitudes of the planets, problems relating to the daily rotation of the heavens, eclipses of the sun and moon, risings and settings, the lunar crescent, and conjunctions of the planets.

Brahmadeva's commentary, dealing partly with trigonometry and its applications to astronomy, was particularly popular in Madras, Mysore, and Maharashtra.

Brahmadeva died at the age of 70, but his reputation as a scientist, mathematician, astronomer, and academician lives on.

### CURIOUS FACT



#### Terms for Numbers

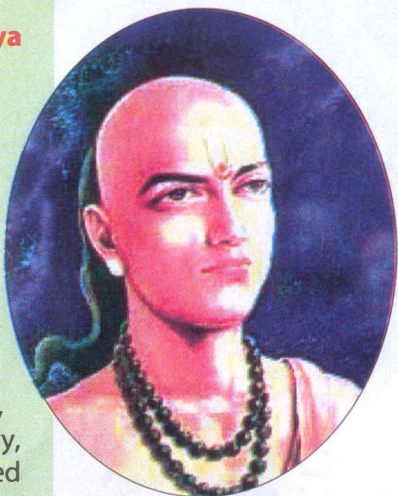
**Bhaskaracharya has given the terms for numbers in multiples of ten. They are eka(1), dasha(10), shata(100), sahasra(1000), ayuta(10,000), laksha(100,000), prayuta (1,000,000=million) and so on.**

## Why is Bhaskaracharya considered a genius?

**B**haskaracharya was a genius in mathematics, especially in algebra and geometry. He was born in Sahyadri, and headed the astronomical observatory in Ujjain.

Bhaskaracharya also known as Bhaskara II (AD 1114-1183), wrote six books on arithmetic, algebra, trigonometry, calculus, geometry, and astronomy. He suggested simple methods to calculate the squares, square roots, cube, and cube roots of big numbers.

The Pythagoras theorem was proved by him in only two lines. Bhaskaracharya wrote about the gravitational force that helps to keep the planets, the sun, and the moon in their respective orbits much before the rest of the world even thought about such an explanation. His work on calculus predates Newton and Leibniz by over half a millennium. He is particularly known for the discovery of the principles of differential calculus, and its application to astronomical problems and computations. His renowned works are 'Lilavati' and 'Bijaganita'.



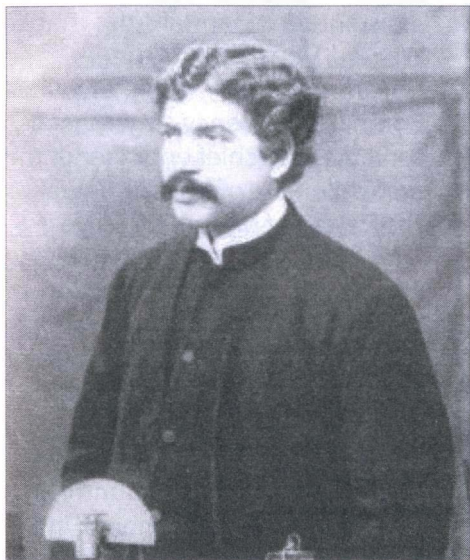
*Bhaskaracharya*

## Why is J.C. Bose honoured to this day?

**J**agadish Chandra Bose, also known as J.C. Bose, was an Indian physicist who pioneered the investigation of radio and microwave optics. He was educated at Calcutta, Cambridge, and London. He studied physical science in St. Xavier's College at Calcutta, and the natural sciences in England. He then joined Presidency



College at Calcutta in 1855 as assistant professor of physics. Most of his important physical and biological experiments were carried out at the Presidency College laboratory. The British government knighted him in 1917.



*Jagadish Chandra Bose*

Jagadish Chandra Bose was one of the pioneers of modern science in India. His research was on the properties of electro-magnetic waves. He is also known for his experiments demonstrating the sensitivity and growth of plants, for which he designed

an extremely sensitive automatic recorder. He found that plants shrink a little during the night, and found out why plants always grow towards light, even if they have to bend. He discovered the reason why some plants grow straight, and some do not. He explained that this was due to the 'pulsation' in plants.

J.C. Bose is the inventor of wireless telegraphy, but before he could register his patent, Guglielmo Marconi secured his patent on wireless telegraphy, and the latter's name appeared in the world record as the inventor.

Jagadish Chandra Bose founded in Calcutta the 'Bose Institute' in November, 1917, with donations from the public. He remained its director till his death on 23<sup>rd</sup> November, 1937.



*Visvesvaraya*

## Why is M. Visvesvaraya a remarkable Indian?

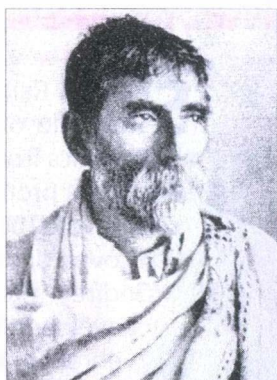
**V**isvesvaraya was an engineer par excellence, a highly respected statesman, and a visionary. He was born in Mysore in 1860. His first job was as an assistant engineer in the Public Works Department under the government of the erstwhile Bombay Presidency. Later, he also served as the chief engineer of the erstwhile state of Mysore, as well as the Dewan of Mysore for six years.

M. Visvesvaraya was the driving force behind the construction of many major dams and water supply schemes, including the famous Krishnaraja Sagar dam. The use of automatic sluice gates, an engineering innovation applied in many dams across the country, was his idea. He was instrumental in the formation of Mysore University as well as the Visvesvaraya College of Engineering and University of Agricultural Sciences. He also played an integral role in setting up the Mysore Iron and Steel Works, and the Bank of Mysore, now known as the State Bank of Mysore. He was honoured with Bharat Ratna in 1955.



## Why is P.C. Ray considered the father of the Indian chemical industry?

**D**r. P.C. Ray, often referred to as Acharya Prafulla Chandra Ray, was a pioneer of chemical industries in India. P.C. Ray was born on August 2<sup>nd</sup> 1861, in Bengal. His father was a rich landowner so he could afford to send the young Prafulla to the UK for higher education, where he got his B.Sc. in 1886, and D.Sc. in 1887. He returned to Kolkata, and became a professor of chemistry in 1889 at Presidency College.



*P.C. Ray*

Dr. P.C. Ray succeeded in isolating mercurous nitrite. Later, Ray and his co-workers studied compounds of metallic elements with organic sulphur derivatives. He worked hard to set up, at a surprisingly low cost, 'The Bengal Chemicals and Pharmaceutical Works Ltd.' using locally available materials. He inspired a generation of young chemists in India, thereby building up an Indian school of chemistry.

Not an ordinary man, but an extra ordinary scientist.



## Why is Ramanujan's life story an amazing one?

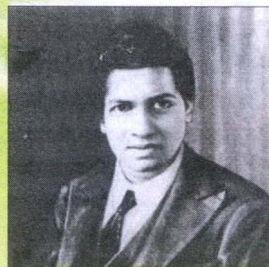
**S**rinivasa Ramanujan's life story is an amazing one. The child of very poor parents, he taught himself mathematics from an elementary English textbook. This self-taught prodigy never graduated from a college, but sent over 100 remarkable theorems that he had discovered, to a great mathematician in Cambridge, Godfrey Hardy. Soon, a regular correspondence developed between the two, and in 1914, Ramanujan enrolled at Trinity College, Cambridge. There, Hardy and Ramanujan began collaborating.

He made contributions to the analytical theory of numbers, and worked on elliptic functions, continued fractions, and infinite series. As he had no formal training in mathematics, he arrived at his results by an almost miraculous intuition.

Ramanujan was elected as Fellow of the Cambridge Philosophical Society, and Fellow of the Royal Society of London in 1918.

He died at a young age in 1920.

It's difficult  
to find a question  
to this answer.



*Ramanujan*





*C.V. Raman*

## Who won the Nobel Prize for Physics in 1930?

**C**handrasekhara Venkata Raman, or Sir C.V. Raman, as he is popularly known, was born in 1888 in Tamil Nadu. He obtained a master's degree in physics in 1907. He topped the Financial Civil Service Competitive Examination, and was appointed deputy accountant general in Calcutta. He later became professor of physics in Calcutta, and in 1928, became the director of the Indian Institute of Science, Bangalore.

There in 1943, Raman founded his own institute near Bangalore, The Raman Research Institute.

C.V. Raman was awarded the Nobel Prize for Physics in 1930, for his discovery of the 'Raman Effect'. It opened up the unknown routes to unveil the mysteries of light wave optics, acoustics, and colloids.

C.V. Raman was conferred the highest title of 'Bharat Ratna' in 1954. He passed away in 1970, and to this day, is honoured as one of the greatest scientists India has ever seen.

## S.R. Kashyap

**Professor Kashyap is called the Father of Indian bryology. He was the first secretary of the Indian Botanical Society, and president of Indian Science Congress in 1932. He is known mainly for the work on Bryophyta, and discovered some new genera and many new species of Bryophyta. Bryology is the branch of botany concerned with the scientific study of bryophytes (mosses, liverworts, and hornworts).**

## Why is Professor Sahni called the father of paleobotany?

**D**r Birbal Sahni was the founder of palaeobotanical research in India, and is rightly called 'The father of Indian paleobotany'. He went to Cambridge University for higher studies, obtained his B.Sc. degree from London University, and started his research under an inspiring teacher, Sir Albert Charles Seward. After returning to India, he held faculty positions at Banaras Hindu University, Varanasi and Punjab University, and Lucknow University.

Sahni was a teacher par excellence, and had great passion for palaeobotany. He started teaching this subject from a small corner in the botany department, Lucknow University, and ultimately succeeded in establishing a well-recognized international institute for this subject. The Birbal Sahni Institute of Paleobotany established in 1946 is well known throughout the world today.



*Birbal Sahni*

A precious fern, indeed!





## Dr. Pandurang Sadashiv Khankhoje

**Dr. Pandurang Sadashiv Khankhoje was an Indian revolutionary, scholar, agricultural scientist and historian. He worked as an agricultural scientist in Mexico, on the Mexican corn breeding project, and was appointed director to the Mexican government's department of agriculture. Later, he returned to India, and settled in Nagpur.**



*Mahalanobis*

## Why is Prashanta Chandra Mahalanobis a key figure in the science of statistics?

**P**rashantha Chandra Mahalanobis was born in Calcutta in 1893. He studied in Presidency College, Calcutta and later in Cambridge, where he took mathematics and physics. While in Cambridge, he developed an interest in statistics that ended up overtaking his first love, physics. Mahalanobis was the founder of the Indian Statistical Institute, or ISI, in 1931. He also started a new journal in statistics called 'Sankhya,' and established a division within the ISI called the National Sample Survey. This division, along with Mahalanobis, played an incredibly vital role in the creation of the second five-year economic plan in India. Mahalanobis' contributions to statistics are quite numerous, and his work could always be associated with some field of application too. He received one of the highest civilian awards - the Padma Vibhushan - from the Government of India. He was made a Fellow of the Royal Society London (FRS) in 1945.



*Meghnad Saha*

## **K.C. Mehta**

**K.C. Mehta was a famous scientist whose field of specialization was plant pathology. He is known for his research regarding the recurrence of rust- an infection that affects plants. His research showed that the infection spreads from the Himalayas in the North, and the Nilgiri and Palany Hills in the South.**

## **Who is Meghnad Saha?**

**M**eghnad Saha was an outstanding Indian scientist, who made remarkable contributions to the field of astrophysics. In 1913, he graduated in mathematics from Presidency College, Calcutta. In 1917, Meghnad Saha joined as a lecturer at the University College of Science in Calcutta. He taught quantum physics.

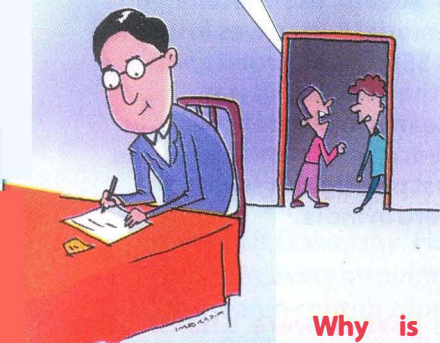
In 1919, the American Astrophysical Journal published a research paper by Meghnad Saha. In this paper, he put forward an 'ionization formula,' which proved to be a breakthrough in astrophysics.

In 1927, Meghnad Saha was elected as a Fellow of London's Royal Society. He moved to Allahabad and in 1932, established the Uttar Pradesh Academy of Science.

In 1947, Meghnad Saha founded the Institute of Nuclear Physics, which later was named after him. He made the first effort to include nuclear physics in the curriculum of higher studies of science.



Don't disturb.  
My boss is working  
on the Boson  
theory.



*Satyendra Nath Bose*

### **Why is Sathyendra Nath Bose associated with Einstein?**

**I**ndian physicist Satyendra Nath Bose is known for working with Albert Einstein.

In 1919, Bose and Saha prepared the first English-language book based on German and French translations of Albert Einstein's original, special, and general relativity papers.

Bose's first article on theoretical physics was on 'Equation of State', based on research conducted and published jointly with Meghnad Saha. Incorporating the Theory of Relativity propounded by Albert Einstein, this equation explained many aspects of the



## Bhatnagar Memorial Award

After Shanti Swarup Bhatnagar's death, the Bhatnagar Memorial Award was instituted in 1958. It is awarded annually by the CSIR for outstanding research in different fields of science, and is considered the most prestigious scientific award in India.

pressure, cubic measure, and temperature of gases. This article was published in 1918.

Scientists now refer to it as the 'Saha-Bose Equation'. Einstein systematically adapted Bose's approach in his own work. That is why this particular field of Bose's research has come to be known as 'Bose-Einstein Statistics'. Later, Bose got an opportunity to meet Einstein, and substantiate his theories. Quantum statistics, a well-known branch of science today, was yet to see the light of day. Bose's theoretical exposition developed this branch.

## What were Shanti Swarup Bhatnagar's contributions to the nation?

Shanti Swarup Bhatnagar played a significant role in the building of post-independent India's science and technology infrastructure and in the formulation of India's science and technology policies. He was the founder director of the Council of Scientific and Industrial Research or CSIR, which was later to become a major agency for research in independent India. He was the



first chairman of the University Grants Commission.

Bhatnagar was a university professor for 19 years, first at the Banaras Hindu University, and then at the Punjab University. He had a reputation as a very inspiring teacher. His research contribution in the areas of magneto chemistry and physical chemistry of emulsion were widely recognised. He also did considerable work in applied, and industrial chemistry. The first industrial problem undertaken by Bhatnagar was the development of a process to convert bagasse -peelings of sugarcane- into food cake for cattle. Bhatnagar, jointly with K.N. Mathur, wrote a book 'Physical Principles and Application of Magneto Chemistry' which is recognised as a standard work on the subject

In 1936, the British Government conferred on Bhatnagar the Order

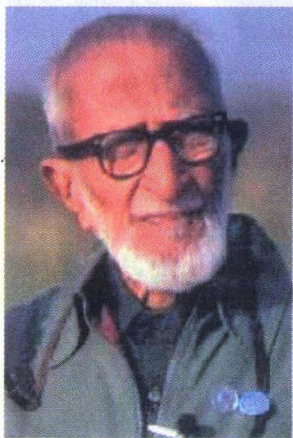
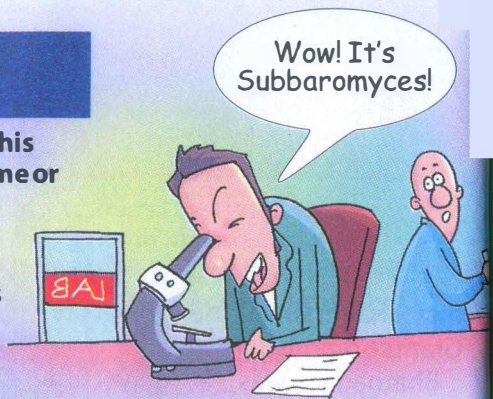


*Shanti Swarup Bhatnagar*

of British Empire, for his excellent contribution to pure and applied chemistry. Bhatnagar was knighted in 1941, in recognition of his work for the war effort. He was the president of the Indian Chemical Society, National Institute of Sciences of India, and the Indian National Science Congress. He was awarded the title Padma Vibhushan by the President of India.

## Fungus named after a Scientist

Subbarao never marketed his work, and never sought fame or recognition. But American Cyanamid Company honoured Subbarao by naming a new fungus in his name, 'Subbaromyces splendens'.



*Salim Ali*

## Why was Salim Ali known as 'The Birdman of India'?

**K**nown as the 'Birdman of India', Dr. Salim Ali's name has become synonymous with birds. One of the greatest ornithologists and naturalists of all time, he was one of the very first scientists to carry out systematic bird surveys in India and abroad. Salim Ali published a research paper discussing the nature and activities of the weaver bird in 1930. The paper made him famous, and established his name in the field of ornithology. He travelled widely to find out more about different species of birds, and published many books, including 'The Book of Indian Birds,' based on his findings. The Government of India honoured him with the Padma Bhushan in 1958, and the Padma Vibhushan in 1976.





*Y. Subbarao*

## Why is Y. Subbarao considered a world class scientist?

**Y.** Subbarao was an Indian biochemist. He spent most of his career in the US, and led some of the most important medical research during World War II. He first became famous with the discovery of an estimation of phosphorous in body fluids and tissues, along with another scientist, Cyrus Fiske. This method of estimation came to be known as the Fiske- Subbarao Method.

Subbarao's name entered biochemistry textbooks with the discovery of adenosine triphosphate and phospho-creatine, or ATP, which are the sources of energy in human body. In medicine, Subbarao discovered many antibiotics and also helped to develop a drug used in the treatment of cancer. He was recognized as one of the most eminent medical minds of the last century.

## Birth of a Birdwatcher

**Salim Ali's interest in birds started at the age of 10. He picked up a fallen bird that looked like a house sparrow but had a yellowish throat. He wanted to know what kind of bird it was, so his uncle took him to meet W.S. Millard, the Honorary Secretary of the Bombay Natural History Society. The meeting was the turning point in Salim Ali's life for it sparked his interest in birds and bird watching.**



## Why was K.S.Krishnan an outstanding scientist?

**K**.S. Krishnan was an Indian physicist who worked with Sir C.V.Raman, and played a significant role in the discovery of the Raman Effect. He was an outstanding physicist as well as an erudite scholar in philosophy, and has been a role model of a teacher to a whole generation of Indian scientists.

In the early 1920s, Raman started his studies on the scattering of light from various materials, having already made a mark by his work in acoustics, especially the behaviour of Indian musical instruments. In 1928, K.S. Krishnan shared in the excitement of discovering the Raman Effect along with his mentor, C.V. Raman. Later, Krishnan used his innovative experimental skills to set



*K.S. Krishnan*

up a new method of measuring the anisotropy of magnetic susceptibility in crystals. These investigations of Krishnan, in light scattering and magnetic measurements, were considered so profound that he was elected to the Fellowship of the Royal Society, London in 1940, at the relatively young age of 42 years. In 1942, K.S. Krishnan was made the professor and head of the department of physics at the University of Allahabad. In 1947, he moved to Delhi to become the Director of the National Physical Laboratory.

### **Tribute from Nehru**

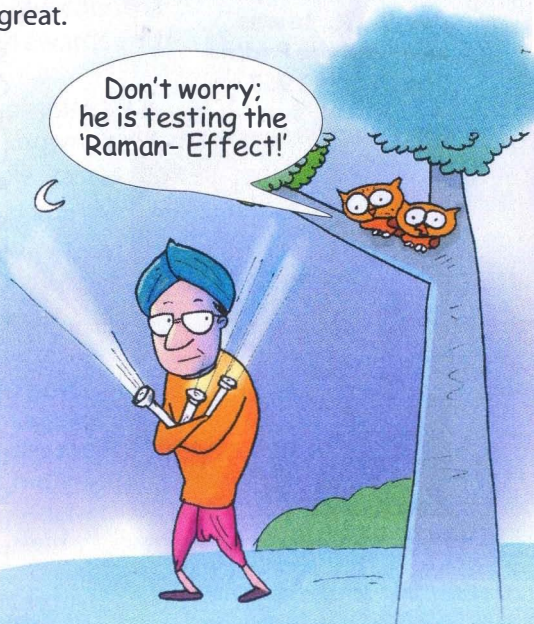
**Jawaharlal Nehru paid tribute to K.S. Krishnan by declaring "he is a great scientist but is something much more. He is a perfect citizen, a whole man with an integrated personality."**

## K.R. Ramanathan

**K.R. Ramanathan was an Indian physicist and meteorologist. He was the first director of the Physical Research Laboratory in Ahmedabad. He was awarded the Padma Bhushan in 1965, and the Padma Vibhushan in 1976. He established Dobson ozone spectrophotometer stations in India.**

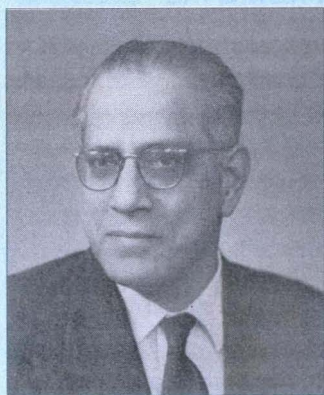
K.S. Krishnan made pioneering contributions in a number of fields of physics, and had the ability to recognize and exploit connection between phenomena in different fields of physics. He also played an important role in the development of science and technology in India. He was deeply associated with the premier scientific and educational organizations in the country like the Atomic Energy Commission, the Council of Scientific and Industrial Research, and the University Grants

Commission. He was knighted in 1946 and awarded the Padma Bhushan by the Government of India in 1954. He was also the first recipient of the prestigious Bhatnagar Award in 1958. K.S. Krishnan was perhaps a current day model of the ancient sages or rishis, who made India great.



## Tiruvenkata Rajendra Seshadri

**Tiruvenkata Rajendra Seshadri was an Indian phytochemist who published more than 1000 papers, and discovered many chemicals from plants. He was also a model teacher who had more than 150 PhD students. He guided them, helped them write their theses, and even assisted them financially if they needed it. He was awarded the Padma Bhushan in 1963.**



*T. R. Seshadri*

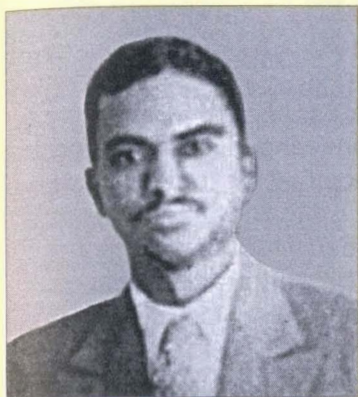
## Why is K.R. Rao considered a pioneer in NQR Spectroscopy?

**K**.R. Rao, or Kotcherlakota Rangadhama Rao to give him his full name, was an Indian physicist who is best known for his work in the field of spectroscopy and the development of the nuclear quadrupole resonance or NQR.

Dr. Rao conducted research on atomic spectra at the Imperial College of Science and Technology in London under the guidance of Professor A. Fowler. He subsequently returned to India to start research work on the nuclear quadrupole resonance in the laboratories of the Andhra University.

Dr. Rao's contribution to the world of physics in general, and spectroscopy in particular, is immense. Being an eminent name





*K.R. Rao*

in the history of physics in the country, he is remembered through awards and honours named after him.

Apart from his role as physicist, Dr. Rao has always been known as a nationalist, for his simple tastes in lifestyle and dress.



### Memorial Lecture Award

**The Rangadhama Rao Memorial Lecture Award was established by the National Institute of Sciences of India in 1979. It is given for outstanding contributions in the field of spectroscopy.**

## Why is Kedareshwar Banerjee remembered to this day?

**K**edareshwar Banerjee or K. Banerjee was a pioneering X-ray crystallographer and director of the Indian Association for the Cultivation of Science, Kolkata. He was born in 1900 in Dacca, and in 1923, after a brilliant academic career, joined the research group of Sir C.V. Raman at the Indian Association for the Cultivation of Science or IACS. He worked in various institutions including IACS, the Indian Meteorological Department, Dacca University and Allahabad University. He retired as the director of IACS in 1965.

Banerjee laid the foundation of X-ray crystallographic research in India. In 1924, when only a few crystal structures had been determined throughout the world, Banerjee's work on the determination of atomic arrangements in crystalline naphthalene and anthracene received international attention.

Apart from structural X-ray crystallography, Banerjee's research pursuits covered a wide field of crystal physics.

Sir, the crystals are ready! Teach me some crystal physics.





*P. Maheshwari*

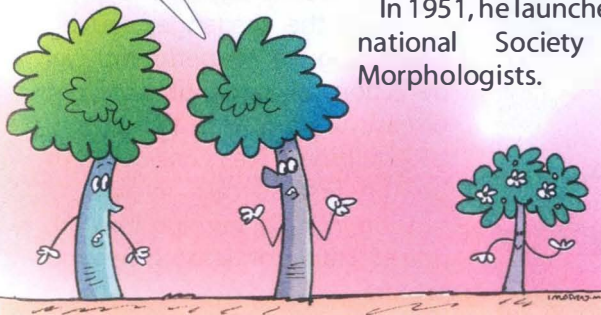
## Why is P. Maheshwari considered a great botanist?

**P**rof. P. Maheshwari was an Indian botanist who is known worldwide for his research on the embryology of plants. He was born in Jaipur in 1904.

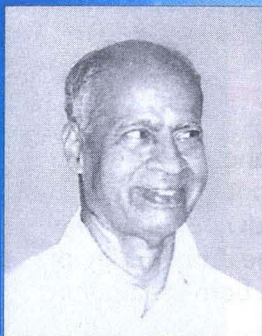
Maheshwari invented the technique of test-tube fertilization of angiosperms. Till then, no one thought that flowering plants could be fertilized in test-tubes. As a result of this technique, more flowering plants could now be cross-bred. The technique proved to be of immense help to plant breeders, and opened up new avenues in economic applied botany. His work, 'An Introduction to the Embryology of Angiosperms' is a classic in that field.

In 1951, he launched the International Society of Plant Morphologists.

Do you know  
that he is a  
testtube plant?







*P.R. Pisharody*

## Why is P.R. Pisharody called the Father of Remote Sensing in India?

**P**.R.Pisharody was born in Kerala and completed his early education in that state.

During the summer vacations he used to work under Prof. C. V. Raman at the Indian Institute of Science, Bangalore. Pisharody then joined the University of California.

On his return to India, Pisharody became the director of the Colaba and Alibag Magnetic Observatories in 1959, and founder director of the Indian Institute of Tropical Meteorology, Pune in 1962.

Pisharody served as the director, Remote Sensing and Satellite Meteorology, at ISRO Space Applications Centre. He was entrusted with the job of introducing remote sensing technology in India. He accepted the challenge, and his pioneering experiment of detection of coconut wilt-root disease using Soviet aircraft and US equipment was considered to be the first success in remote sensing in India, earning him the title of 'Father of Remote Sensing in India'.

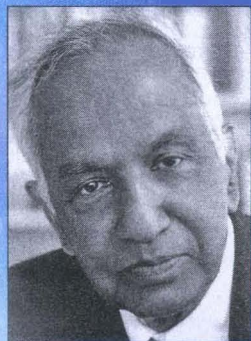


Remote sensing is better than sixth sense.

## Why will Subrahmanyan Chandrasekar always be remembered?

**S**ubrahmanyan Chandrasekar was an Indian-born, American astrophysicist. The nephew of Sir C.V. Raman, he was educated in Madras, before going on to Cambridge University, and later to the USA, where he worked at the University of Chicago, and the Yerkes Observatory. He explored astrophysical subjects such as stellar structure, the theory of white dwarf stars, and the mathematical theory of black holes. He edited the *Astrophysical Journal* for nearly 20 years, and in 1983, shared the Nobel Prize for Physics with William A. Fowler, for key discoveries that led to the currently accepted theory, on the later evolutionary stages of massive stars. His last book was 'Newton's Principia for the Common Reader'.

NASA renamed their advanced X-ray astrophysics facility as the Chandra X-Ray Observatory in his honour.



*S. Chandrasekhar*

## Kailas Nath Kaul

**Professor Kailas Nath Kaul was an Indian botanist, agronomist, agricultural scientist, horticulturist, herbalist, and naturalist. He established the National Botanical Gardens at Lucknow in 1948. He remained director of the Botanical Gardens till 1965. In this period, the National Botanical Gardens, Lucknow, became one of the world's five best botanical gardens.**



## Why is Homi Bhabha considered the founder of India's atomic energy programme?

**H**omi Bhabha, whose full name was Homi Jehangir Bhabha, is a famous Indian atomic scientist. With the support of Jawaharlal Nehru, he laid the foundation for India's scientific growth, and was responsible for the creation of two premier institutions, the Tata Institute of Fundamental Research, and Bhabha Atomic Research Centre. He was also the first chairman of India's Atomic Energy Commission.

After graduating from Elphinstone College, and the Royal Institute of Science in Bombay, Bhabha went to Cambridge University. When World War II broke out, Bhabha, returned to India.



*G.N. Ramachandran*

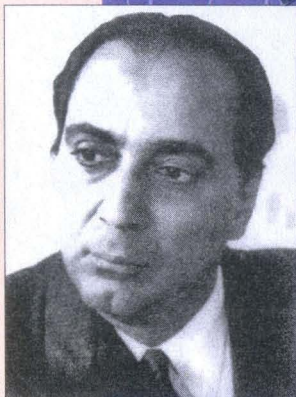
## Why are G.N. Ramachandran's contributions to science important?

**G**.N. Ramachandran was a physicist who won laurels for his work that led to the creation of what is known as the Ramachandran Plot for understanding peptide structure. Born in Kerala, he joined the Indian Institute of Science, Bangalore in 1942, where he



In 1939, he set up the Cosmic Ray Research Unit at the Indian Institute of Science, Bangalore, under C.V. Raman. With the help of J.R.D. Tata, he established the Tata Institute of Fundamental Research at Mumbai, in 1945. He established the Atomic Energy Commission of India in 1948. Under his guidance, Indian scientists worked on the development of atomic energy, and the first atomic reactor in Asia went into operation at Trombay, near Bombay, in 1956.

The climax of India's atomic energy programme came on May 18<sup>th</sup>, 1974 when India exploded a nuclear device at Pokhran, Rajasthan, joining a select club of nations. He died in 1966 in a plane crash in Mont Blanc, the highest mountain in the Alps.



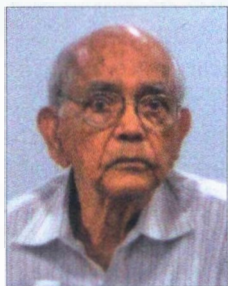
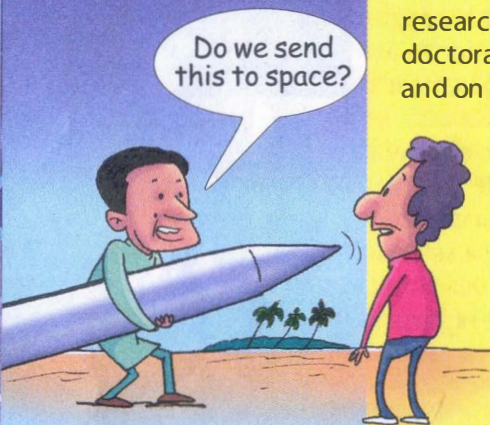
*Homi Bhabha*

worked with C.V. Raman. Later, he went to Cambridge and after completing his PhD, returned to the institute.

Using X-ray diffraction, Ramachandran, along with Gopinath Kartha, proposed and published the triple helical structure of collagen in 1954. After years of research, he published the Ramachandran Plot in the Journal of Molecular Biology. He founded the molecular biophysics unit at the Indian Institute of Science, and was the recipient of the Bhatnagar Award, among the many other honours that he received.

## Why is Vikram Sarabhai called 'The Father of the Indian Space Programme'?

**D**r. Vikram Ambalal Sarabhai, the father of the Indian space programme has put India on the international map in the field of space research. In 1947, he was awarded a doctorate by Cambridge University, and on his return to India, Dr. Sarabhai founded the Physical Research Laboratory known as PRL. In 1962, he took over the responsibility of organizing space research in India as Chairman of the Indian National Committee for Space Research. He directed the setting up of the Thumba



*C. R. Rao*

## Why is C.R. Rao internationally renowned?

**C**.R. Rao is an Indian-American mathematician and statistician.

C.R. Rao caught the attention of the world with his 'theory of estimation'. He returned to India and joined ISI as a professor. He placed emphasis on the training section of the ISI, and also assumed responsibility as the assistant



Equatorial Rocket Launching Station at Thiruvananthapuram.

The establishment of the Indian Space Research Organization, also known as ISRO, was one of his greatest achievements. After a remarkable effort, the inaugural flight was launched on November 21<sup>st</sup>, 1963. Sarabhai started a project for the fabrication and launch of an Indian satellite, and the first Indian satellite, Aryabhata, was put in orbit in 1975 from a Russian cosmodrome.

Dr. Sarabhai was a creative scientist, a successful and forward-looking industrialist, an innovator of the highest



*Vikram Sarabhai*

order, an educationist, a connoisseur of arts, an entrepreneur of social change, a pioneering management educator, and so much more.

editor of Sankhya- the Indian Journal of Statistics. He left ISI in 1978 to join the University of Pittsburgh, but came back and retired as the director of ISI.

After his retirement, he moved to Pennsylvania. C.R. Rao has received the Padma Bhushan, and is a Fellow of the Royal Society, UK.

## **R.P. Roy**

**R.P. Roy is a distinguished scientist whose work in cytogenetics, plant breeding, tissue culture and cytotaxonomy won him many laurels. He was president of the Indian Science Congress in 1972.**



## Why are Har Gobind Khorana's scientific contributions important?

**H**ar Gobind Khorana is an Indian-born, American organic chemist and biochemist. He was awarded a Ph.D in organic chemistry by Liverpool University, and was a research fellow at Cambridge before moving to Vancouver as head of the department of organic chemistry.

Khorana's early work was on the biochemistry of enzymes, but in the 1960s, he turned to the nucleic acids and the genetic code. In the early 1970s, he was one of the first to artificially synthesize a gene, initially from yeast, and then later, from the bacterium *Escherichia coli*. Har Gobind Khorana is best known for developing chemical methods to determine the nucleotide sequence of ribonucleic acid or RNA, and for deciphering the genetic code. For this, he shared the 1968 Nobel Prize for Physiology or Medicine, with Marshall Nirenberg and Robert Holley.



*Har Gobind Khorana*



## K.S. Chandrasekhar

**K.S. Chandrasekhar was a founding faculty member of the School of Mathematics, Tata Institute of Fundamental Research. He is known for his work in number theory and summability, and was given numerous awards.**

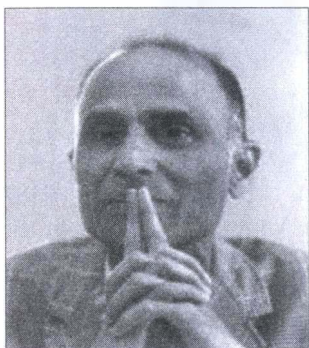
**Chandrasekhar persuaded mathematicians from all over the world, to visit TIFR, and deliver courses of lectures.**

## Why is Harish Chandra considered to be an extraordinary mathematician?

**H**arish Chandra was an Indian-American mathematician and physicist who is famed for the fundamental work he carried out in what is known as Representation Theory.

After getting his master's degree in 1943, he worked with Homi Bhabha at the Indian Institute of Science, Bangalore. Later, he moved to the Cambridge, Harvard and Columbia Universities.

It was in Columbia University, during the period from 1950 to 1963 that he carried out studies on 'Semisimple Lie

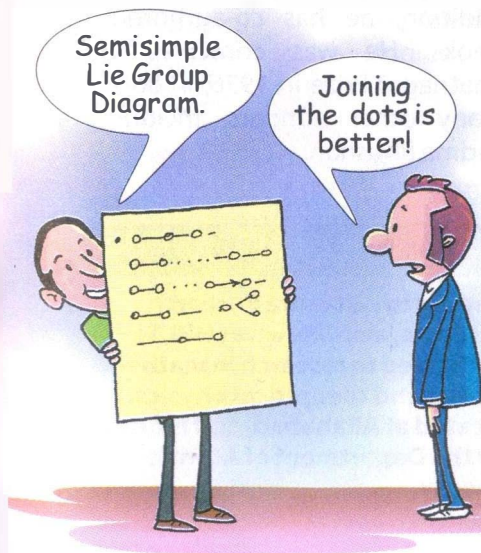


*Harish Chandra*

Group Algebra,' which were considered to be his best research.

In 1973, he became a Fellow of the Royal Society. The Indian National Science Academy in 1974 awarded him the Ramanujan Medal. In 1981, he was made a Fellow of the National Academy of Sciences in the US.

Harish Chandra's contributions to the 'Representation Theory of Lie Groups', harmonic analysis, and related areas left researchers a rich legacy that continues to this day.





## What is A.K. Sharma famous for?

**A**.K. Sharma is a professor at the Centre of Advanced Study on Cell and Chromosome Research, Department of Botany, University of Calcutta. He has been deeply interested in the areas of cytogenetics, cytochemistry and cell biology.

Sharma is famous for his work on new techniques for studying the physical and chemical nature of chromosomes, which is now adopted all over the world for plant, animal, and human systems. He also clarified the chemical nature of plant chromosomes through specially evolved techniques, and has many other research achievements to his credit. In addition, he has co-authored many books. He was conferred the SS Bhatnagar Prize in 1976, in addition to many other honours, including the Padma Bhushan.

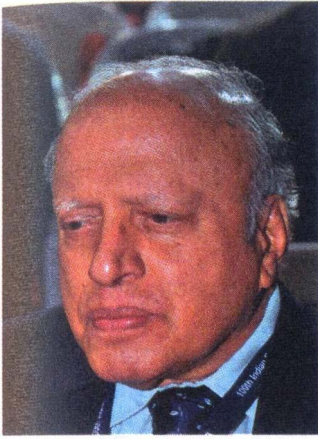
**STAR FACT**



### HRI

**The Harish Chandra Research Institute, also known as HRI, is dedicated to research in mathematics and theoretical physics. It is located at Allahabad, and is funded by the Department of Atomic Energy.**





*M.S. Swaminathan*

## Why is M.S. Swaminathan associated with the 'Green Revolution' in India?

**M**.S. Swaminathan is a scientist who helped redirect India's future in agriculture. His work led to the development of new varieties of wheat and rice that yielded larger-than-usual amounts of grain. This was a primary factor in India's Green Revolution, which set in motion fundamental changes in agricultural production.

Within two years of the introduction of Swaminathan's Japanese-Mexican wheat hybrid, Indian wheat production rose from 10 million tonnes a year to 18 million tonnes.

Scientists under Swaminathan's direction made similar breakthroughs with rice. U.S. scientist William Gaud coined the term 'Green Revolution' to describe Swaminathan's breakthrough and the term is used to this day.

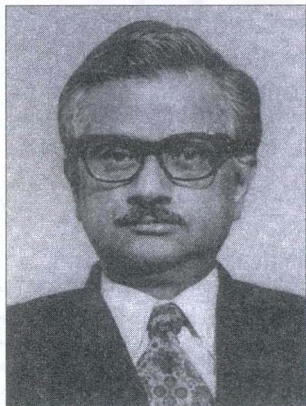
You should consult Dr. M.S. Swaminathan at the earliest!



## Why is Raja Ramanna considered the Father of Indian Nuclear Programme?

**R**aja Ramanna was an Indian physicist and nuclear scientist who is often called the 'Father of Indian Nuclear Programme,' for his direction and leadership of India's nuclear programme for over 40 years. He joined the programme in 1964, and worked under Dr. Homi Bhabha. Later, he directed the programme himself, while expanding and supervising scientific research on nuclear weapons.

Raja Ramanna was the first directing officer of the small team of scientists that supervised and carried out the test of the nuclear device, under the code name 'Smiling Buddha', in 1974. He was also the man mainly responsible for designing and installing the country's first series of nuclear reactors, Apsara, Cirus and Purnima.

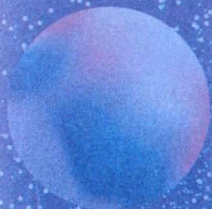


*Raja Ramanna*

Ramanna also initiated the industrial defence programmes for the Indian armed forces. Raja Ramanna was the Union Minister for State for Defence in 1990, and in 1997, became a Member of Parliament through the upper house, the Rajya Sabha.

### Science and Music

**Raja Ramana was a multifaceted personality- an eminent nuclear physicist, a gifted musician, and a scholar of Sanskrit literature. He was a connoisseur of music, and has written a book about music too. He studied western classical music, and gave several concerts that bore testimony to his musical talent.**



*Vainu Bappu*

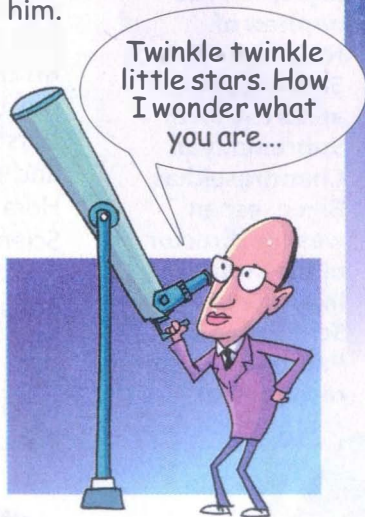
### **Why is Vainu Bappu called the Father of Indian astronomy in independent India?**

**V**ainu Bappu has contributed much to the revival of optical astronomy in India. Bappu joined the Harvard University on a scholarship. Soon after this, he discovered a comet, and it was named Bappu- Bok-Newkirk after him and his colleagues, Bart Bok and Gordon Newkirk.

Later, Bappu joined the Palomar University, and with another astronomer, Colin Wilson, made an important observation about the luminosity of a particular kind of stars – and this came to be known as the Bappu - Wilson Effect.

Bappu returned to India in 1953, and played a major role in building the Uttar Pradesh State

Observatory in Nainital. In 1986, he established an observatory in Kavalur, Tamil Nadu. It was named the Vainu Bappu Observatory after him.







## **S. Ramaseshan**

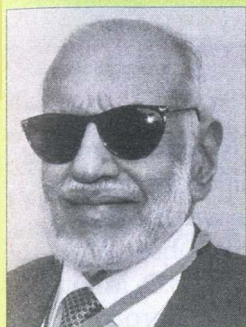
**S. Ramaseshan was an Indian scientist who is renowned for his work in the field of crystallography. The nephew of Nobel Laureate Sir C. V. Raman, and a cousin of Subramanyan Chandrasekhar, Ramaseshan was the director of the Indian Institute of Science, and a Padma Bhushan recipient.**

## **Why is M.O.P. Iyengar referred to as the 'Father of Algology in India'?**

**M**.O.P. Iyengar was an Indian botanist and phycologist who devoted his life to studying the structure, cytology, reproduction, and taxonomy of a major group of algae. He spent a good part of his life teaching at the Presidency College, Madras, and was later professor at the university research laboratory.

Before Iyengar's time, knowledge of Indian algal flora was minimal. Iyengar's earlier studies began with the volvocales, and these provided the material for his publications. He established the School of Algology in the University of Madras, and had several firsts to his credit throughout his career. He was the first recipient of the prestigious 'Birbal Sahni Medal' for outstanding work in the field of botany, and the first recipient of 'The Sunder Lal Hora Medal' from the Indian National Science Academy.

M.O.P. Iyengar's pioneering contributions to the fields of botany, algology and phycology were so well appreciated by the scientific community in India, that he was referred to as the 'Father of Algology in India'.



*M.G.K. Menon*

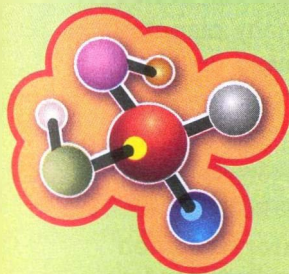
## Why is M.G.K. Menon considered a scientist par excellence?

**P**rof. M.G.K. Menon is a distinguished physicist who has played a key role in the development of science and technology in India.

Prof. Menon has had a role in almost every facet of science and technology development in the country, but the important one was in nurturing the Tata Institute of Fundamental Research which his mentor Homi J. Bhabha founded in 1945. He joined the TIFR in 1955. He became the director of the institute in 1966, following Bhabha's untimely death. His able directorship of the TIFR lasted until 1975.

Prof. M.G.K. Menon's research achievements include the development of high-precision measurement techniques for cosmic rays. He also initiated high-altitude cosmic ray studies near the geomagnetic equator, using balloon flights. This, by its ability to carry X-ray and gamma ray telescopes as payloads, marked the genesis of space-based astronomy in the country. He was also involved in the cosmic ray studies initiated in 1964 in the mines at Kolar Gold Fields.

Prof. Menon has won numerous awards, and the asteroid 7564 Gokumenon was named in his honour in late 2008.



## What are the contributions of Arvind Bhatnagar?

**P**rof. Arvind Bhatnagar is known internationally for his significant contributions to solar astronomy. He was the founder-director of the Udaipur Solar Observatory. Arvind Bhatnagar obtained his Ph.D. in solar physics in 1964. He worked abroad for several years, and then returned to India to establish a unique island solar observatory in the middle of Lake Fatehsagar in Udaipur.

Dr. Bhatnagar co-authored a fascinating book on solar physics entitled 'Fundamentals of Solar Astronomy'. He was a founder member of the Astronomical Society of India, and a member of the International Astronomical Union.

Dr. Bhatnagar was the founder director of the Nehru Planetarium, Mumbai from 1976 to 1978, and advisor to many planetaria in the country. He passed away on May 18<sup>th</sup>, 2006.

### Telescope City



**The Vainu Bappu Observatory is owned and operated by the Indian Institute for Astrophysics, which was also founded by Vainu Bappu. It is located in the Vellore district of Tamil Nadu, and is referred to as 'Telescope City'.**

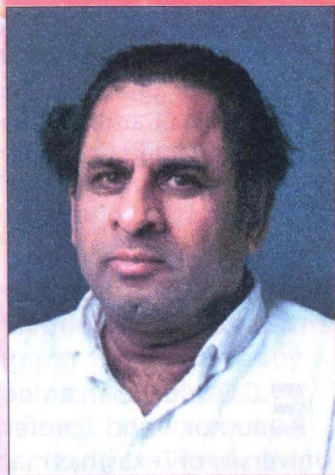


## Why is Shreeram Shankar Abhyankar considered a great mathematician?

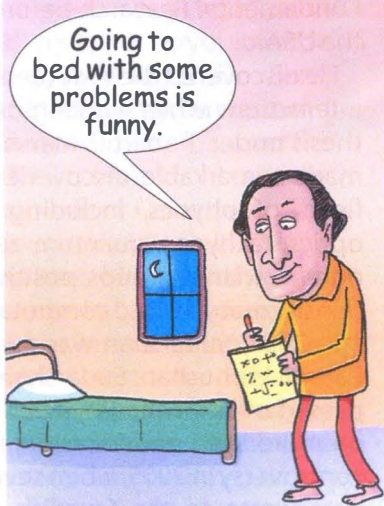
**S**hreeram Shankar Abhyankar is an Indian-American mathematician, who took his PhD from Harvard in 1955. He is known for his contributions to algebraic geometry, and his research also covered commutative algebra, local algebra, and valuation theory, theory of functions of several complex variables, quantum electrodynamics, circuit theory, combinatorics, computer-aided design, and robotics. Combinatorics is a branch of mathematics.

Abhyankar, who headed the University of Purdue's mathematics department from 1978 to 1985, had founded Bhaskaracharya Pratishthana in Pune to cultivate the interest of teachers and students in mathematics.

Shreeram Shankar Abhyankar passed away on 2<sup>nd</sup> November, 2012.



*Shreeram Shankar  
Abhyankar*



## Chandrasekhar Limit

The term 'Chandrasekhar Limit' was coined after Subrahmanyan Chandrasekhar, who predicted it in 1930, at the age of 19. It is the maximum mass of a stable white dwarf star. A white dwarf star's mass is comparable to that of the sun and the volume is comparable to that of the Earth.

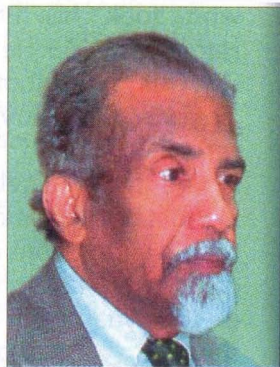
### Why is E.C.G. Sudarshan considered an outstanding scientist?

**E**.C.G. Sudarshan, an Indian physicist, author, and professor at the University of Texas, has made significant contributions to several areas of physics.

Born in Kerala, he obtained his master's degree from Madras Christian College, and then moved to the Tata Institute of Fundamental Research before going to the USA.

He discovered the V - A theory of weak interactions while working on his Ph D thesis under Robert E. Marshak. He has made remarkable discoveries in many fields of physics, including quantum optics, tachyons, quantum zeno effect, non-invariance groups, positive maps of density matrices and computation.

In 2007, Sudarshan was awarded the Padma Vibhushan. Sudarshan has been passed over for the Physics Nobel Prize on more than one occasion, leading to controversy in 2005, when several physicists wrote to the Swedish Academy,



*E.C.G Sudarshan*

protesting that Sudarshan should have been awarded a share of the Prize for the Sudarshan diagonal representation (also known as Sudarshan-Glauber representation) in quantum optics. Roy J. Glauber won the Nobel prize in 2005.



*Subhas Mukherjee*

## **What was Subhas Mukherjee's outstanding contribution?**

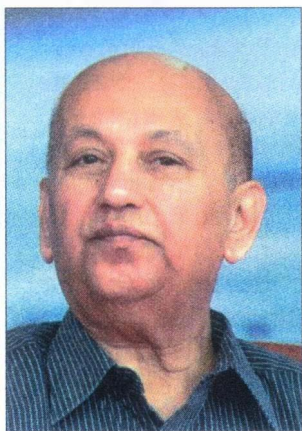
**D**r. Subhas Mukherjee, an Indian physician from Calcutta, made news when he became the first physician in India to perform the first 'in- vitro fertilization' resulting in a test- tube baby 'Durga'. He will always be remembered as an unsung hero, who discovered the easiest and most successful way of producing a test-tube baby.

On 3<sup>rd</sup> October 1978, Subhas Mukherjee along with Sunit Mukherjee, a cryobiologist, and gynaecologist Dr. Saroj KantiBhattacharya, announced the birth of India's first, and the world's second test-tube baby, in Calcutta. The announcement came 67 days after the birth of the first test-tube baby in England.

Today, more than three million test-tube babies worldwide see the light of day from Dr. Subhas Mukherjee discovered method.







*U.R. Rao*

## Why is U.R. Rao's name synonymous with satellite technology in India?

**P**rof. U.R. Rao, a space scientist and former chairman of the Indian Space Research Organization, started his career as a cosmic ray scientist under Dr. Vikram Sarabhai.

He was the first to establish the continuous nature of the solar wind and its effect on geomagnetism, and undertook the responsibility of establishing of satellite technology in India in 1972.

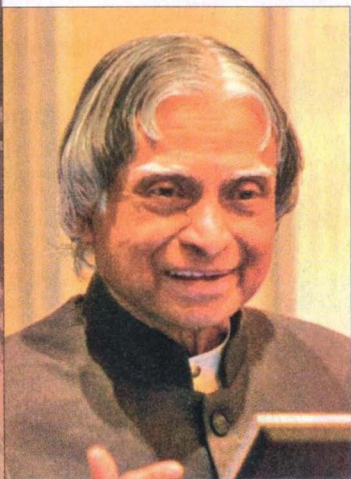
Over 20 satellites were designed and launched for providing communication, remote sensing, and meteorological services under his guidance, beginning with the Aryabhata in 1975.

As Chairman, Space Commission and Secretary, Department of Space, Rao accelerated the development of rocket technology, resulting in the successful launch of the ASLV rocket in 1992.

He was also responsible for the successful launch of INSAT satellites which provided telecommunication links to the remote corners of India.

Dr. U. R. Rao, is the first Indian space scientist to be inducted into the Satellite Hall of Fame, and he has received many honours and awards, including the Padma Bhushan.





*A.P.J. Abdul Kalam*

**Which famous  
scientist became  
President of India?**

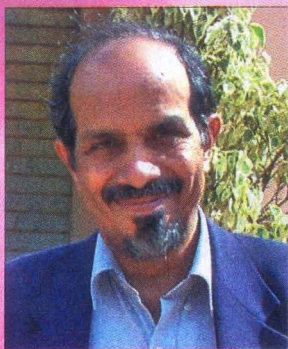
**D**r. A.P.J. Abdul Kalam will go down in history as a distinguished scientist and administrator who became the 11<sup>th</sup> president of India.

He was born in October 1931, in Rameswaram. Even as a young boy, he had admired the flight

of birds, and developed a fascination for the subject of flight. He therefore opted for a course in aeronautical engineering at the Madras Institute of Technology, or MIT.

In the 1960s, Kalam joined the Vikram Sarabhai Space Centre in Kerala. He played a major role in the centre's evolution to a key hub of space research in India. Kalam played a pivotal role in India's Pokhran-II nuclear test in 1998. In 1981, the Government of India awarded him, the Padma Bhushan and then, the Padma Vibhushan in 1990, and the Bharat Ratna in 1997.

Apart from being a notable scientist, he is a man of vision, who is always full of ideas aimed at the development of the country which is why he is often referred to as the 'missile man of India.'



*Roddam Narasimha*

### Ramanujan Number

**The number 1729 is known as the Ramanujan Number. Once Professor G.H.Hardy told Ramanujan that 1729 was the number of the taxi cab in which he came to the hospital. Ramanujan at once pointed out that it is the smallest number that can be expressed as the sum of two cubes in two different ways.**

### What do we know about Roddam Narasimha?

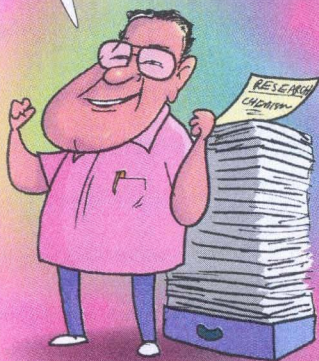
**D**r. Roddam Narasimha is an honorary professor in the engineering mechanics unit at the Jawaharlal Nehru Centre for Advanced Scientific Research. Professor Roddam Narasimha holds a Ph.D.

from the California Institute of Technology, and a master's degree from the Indian Institute of Science. He joined the Indian Institute of Science in 1962, and was associated with the Department of Aerospace Engineering in various capacities till 1999.

Prof. Narasimha's research has been chiefly concerned with aerospace and atmospheric fluid dynamics. Prof. Narasimha is the author of more than 250 research publications, mostly on fluid mechanics, aerospace science, and atmospheric dynamics. His distinctions include the Bhatnagar Prize, the Ramanujan Award, and the Padma Bhushan.



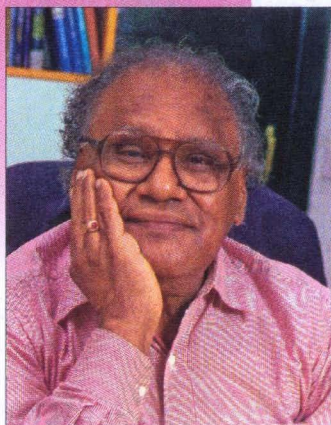
Knowledge is  
Power.



## What are the contributions of C.N.R Rao in solid state chemistry?

**P**rof. C.N.R. Rao is one of the giants of Indian science. The founder of the Jawaharlal Nehru Centre for Advanced Scientific Research in Bangalore, he has also been the chairman of the science advisory council to the prime minister for several years.

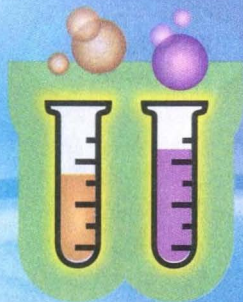
Prof. Rao is one of the world's foremost solid state and materials chemists. Prof. Rao is known for his research into superconductivity, and the chemical properties of superconductive materials. He is also a founding member of the Third World Academy of Sciences. He was awarded the Hughes Medal by the Royal Society in 2000, and in 2004, he became the first recipient of the India Science Award. He has also received the Padma Shri and Padma Vibhushan Awards.



*Prof. Rao*

## Bose and Boson

**In 2012, the European Council for Nuclear Research, announced the possible discovery of the Higgs boson. The term 'boson' honours the work of Calcutta-based, Bengali physicist Satyendra Nath Bose.**



## Who is Vinod Johri?

**V**inod Johri is a distinguished astrophysicist and cosmologist. He has spent over 45 years researching in cosmology, acting as a research guide and principal investigator of various research projects of Council of Scientific and Industrial Research, Department of Science and Technology, and the University Grants Commission of India.

His major contributions in cosmological research include 'power law inflation, genesis of quintessence fields of dark energy and phantom cosmologies'.

Prof. Johri has edited a book 'The Early Universe'. He has been elected a Fellow of the Royal Astronomical Society of London.



*Vinod Johri*



## Why is Dronamraju Krishna Rao famous?

**D**ronamraju Krishna Rao is an Indian born geneticist who is deeply involved in promoting close cooperation between the USA and India in science and technology. Dronamraju is president of the Foundation for Genetic Research, Houston, Texas. He is also an advisor to the White House.

Early in his research career, he discovered the first case of a gene in the human 'Y' chromosome, and published a paper in 1960. His contributions to the mechanisms of speciation in plants and plant-pollinator interaction, and also the pollinating behavior of butterflies are considered quite significant.

In recent years, Dronamraju's research focused on the history of genetics and human as well as medical genetics, resulting in the publication of several books.



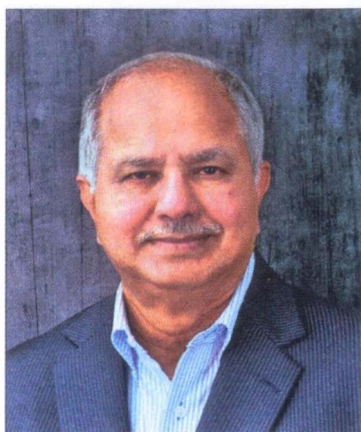
*Dronamraju  
Krishna Rao*



## Raman Effect

**The Raman Effect is the change in the wavelength of light that occurs when a light beam is deflected by molecules. It is named after Sir C.V. Raman, who won a Nobel Prize for his work on the scattering of light, and for the discovery of the Raman Effect.**





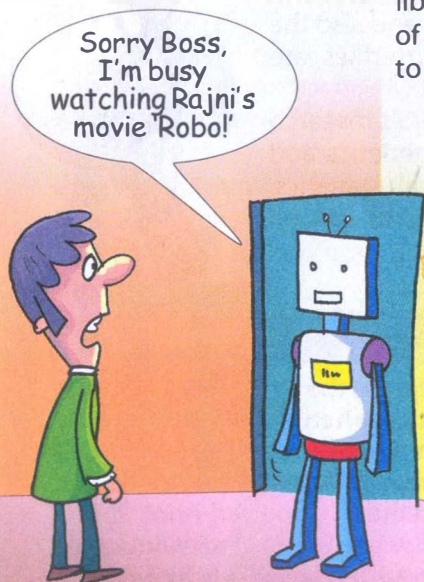
*Raj Reddy*

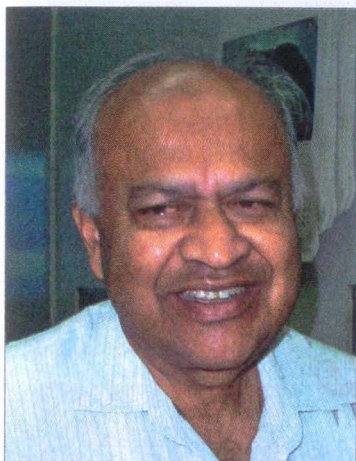
## Why is Raj Reddy considered a brilliant scientist?

**P**rof. Raj Reddy is one of the pioneers in computer science and artificial intelligence. He studied in India and Australia, and received his doctorate in computer science from Stanford University in 1966.

Dr. Reddy's research interests include the study of human-computer interaction, and artificial intelligence. His current research projects include speech recognition and universal digital libraries, where all creative works of the human race are available to anyone, anywhere.

In 1994, he received the most prestigious award in computer science, the Turing Award, jointly with Edward Feigenbaum. Prof. Raj Reddy was awarded the Padma Bhushan in 2001.





*Jayant V. Narlikar*

### **Pioneer of Aviation Technology**

**Acharya Bharadwaj, an ancient Indian sage, authored the 'Yantra Sarvasva,' which includes astonishing and outstanding discoveries in aviation science, space science, and flying machines. His designs and descriptions have stunned even modern-day aviation engineers.**

## **Why is Jayant Narlikar one of India's outstanding scientists?**

**J**ayant V. Narlikar is a renowned astrophysicist. He was born in 1938 in Maharashtra.

After his higher studies in at Cambridge, Dr. Narlikar returned to India to join the Tata Institute of Fundamental Research.

In 1988, he was invited by the University Grants Commission as founder director to set up the proposed Inter-University Centre for Astronomy and Astrophysics, or the IUCAA.

Dr. Narlikar is internationally known for his work in cosmology. Since 1999, he has been heading an international team in pioneering experiments designed to sample air for micro organisms in the atmosphere at heights of up to 41 km. Studies of the samples collected in 2001 and 2005 led to the findings of live cells and bacteria, thus opening up the intriguing possibility that the Earth is being bombarded by microorganisms, some of which might have seeded life itself here.

Dr. Jayant Narlikar was decorated with Padma Bhushan.



### Father of Cosmology

Another ancient Indian sage, who lived in 3000 BC, is called 'The Father of Cosmology'. He was Acharya Kapil, and his works threw light on the nature and principles of the ultimate soul, primal matter, and creation.

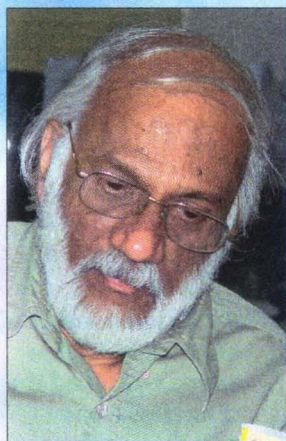
### Why is Govindrajan Padmanabhan renowned?

**G**ovindrajan Padmanabhan, a renowned biochemist and pioneer in Indian biotechnology, is a former director of the Indian Institute of Science, from where he earlier took his PhD in 1966.

He belongs to the Tanjore district of Tamil Nadu. He is settled in Bangalore, and is an honorary professor in the department of biochemistry at IISc.

In the early years of his research, he worked in the transcriptional regulation of eukaryotic genes in the liver. His group discovered the heme-biosynthetic pathway in the malarial parasite.

Prof. Padmanabhan is the recipient of the Shanti Swarup Bhatnagar Award for Science and Technology, as well as the Padma Shri and Padma Bushan awards of the Government of India.



*Govindrajan  
Padmanabhan*



## Who was Ganapathi Thanikaimoni?

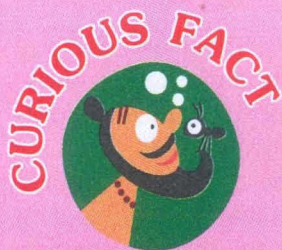
**G**anapathi Thanikaimoni, a reputed botanist, is remembered for his important contributions to the field of palynology.

He joined as a scientist at the French Institute of Pondicherry in 1960. His research with the enlisted species were published in journals that were brought out by the French Institute of Pondicherry from time to time.

Though Ganapathi Thanikaimoni worked on a particular set of species within the plant kingdom, he did not flinch from working on all other plants as well. In fact, he insisted that all species must be studied, if accurate results are to be achieved for a particular set of plants, because behavioural patterns of different species are interrelated. In the year 1972, he received worldwide recognition when his compilation of morphology of angiosperm pollen was published.

Dr. Ganapathi Thanikaimoni was not only involved in the study of pollen, but also tried his best to contribute to the well-being of society, and to educate government authorities to take proper care of coastlines as well as to rehabilitate arid areas across India. He died on September 5<sup>th</sup>, 1986.





### Indian Mathematics

India is considered to be the home of mathematics- and algebra, trigonometry, and calculus, all had their roots here. Quadratic equations were first explained by Sridharacharya in the 11<sup>th</sup> century. The largest numbers the Greeks and the Romans used were  $10^6$ , whereas Indians used numbers as big as  $10^{53}$ . These numbers even had specific names as early as the Vedic period.

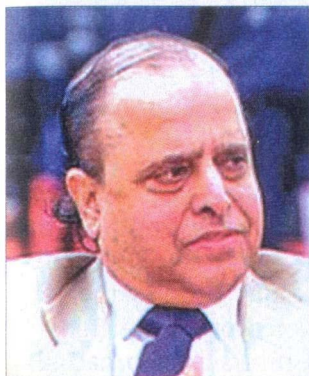
### Why is Krishnaswamy Kasturirangan a remarkable scientist?

**D**r. Krishnaswamy Kasturirangan has been at the helm of the Indian space programme, and is presently a member of the Planning Commission. He was director of the ISRO Satellite Centre, the project director for India's first two experimental Earth observation satellites, and also responsible for overall direction of the first operational Indian remote sensing satellite. As an astrophysicist, Dr. Kasturirangan's interest includes research in high energy X-ray and gamma ray astronomy, as well as

### What do we know about Srikumar Banerjee?



**D**r. Srikumar Banerjee is a metallurgical engineer and nuclear scientist. He is one of the leading experts in materials science and technology in India, and has made outstanding contributions in this field. He has published more



*Kasturirangan*

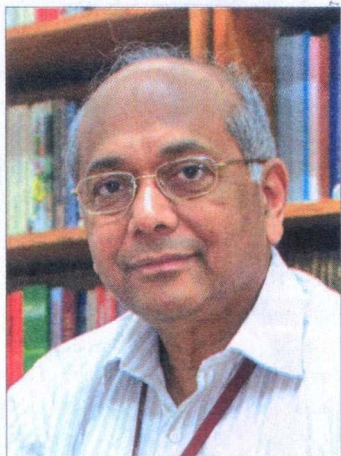
optical astronomy. He has published more than 200 papers, both in international and national journals in the areas of astronomy, space science, space applications and has edited six books. Under his leadership, as chairman, ISRO, the space programme has witnessed several major milestones.

Dr. Kasturirangan is a member of several important scientific academies, both within India, and abroad. He has won several awards including the Shanti Swarup

Bhatnagar Award in Engineering, and has been conferred the Padma Shri, Padma Bhushan, and Padma Vibhushan awards.

than 300 papers on this subject, and some of these have received worldwiderecognitionaslandmark contributions to science.

Dr. Banerjee has held several important positions, including that of the director of the Bhabha Atomic Research Centre, chairman, Atomic Energy Commission, secretary, Department of Atomic Energy, and Homi Bhabha Chair Professor at the Bhabha Atomic Research Centre. He is the recipient of several awards as well, including the Bhatnagar Award, and the Indian Nuclear Society Award.



*Srikumar Banerjee*





*Patcha  
Ramachandra Rao*

**Why is Patcha Ramachandra Rao considered a pioneer in the area of rapid solidification?**

**D**r. Patcha Ramachandra Rao was a world famous scientist and administrator. Interestingly, he was the only vice chancellor of the Benares Hindu University who had also studied and worked there as a member of the faculty.

Dr. Rao pioneered research activities in the area of rapid solidification- the first person outside the US, to conduct research in this technologically important area. Many noteworthy contributions made by Dr. Rao and his students colleagues have put India in a key position in the field of rapid solidification studies.

Dr. Rao also focused on a new area of investigation called biomimetics, and worked on ceramic materials and their production by self-propagating high temperature synthesis. Biomimetics is the study of the structure and function of biological systems as models for the design and engineering of materials and machines.

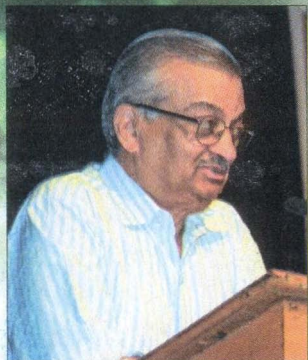
## **Gurdev Khush**

**Dr. Gurdev Singh Khush is an agronomist and geneticist. In 1966, he received the World Food Prize, along with his mentor Dr. Henry Beachell. The prize was awarded for his achievements in enlarging and improving the global supplies of rice during a time of population growth.**



*Gurdev  
Khush*

## What are Anil Kakodkar's contributions to nuclear research in India?



*Anil Kakodkar*

**D**r. Anil Kakodkar, a distinguished nuclear scientist, joined the Bhabha Atomic Research Centre or BARC in 1964, and played a key role in the design and construction of the Dhruva reactor. He was a part of the core team of architects of India's peaceful nuclear tests in 1974 and 1998. During his career spanning four and a half decades, he has built a competent team of highly specialized scientists and engineers for the reactor programme.

In the year 1996, Anil Kakodkar became the youngest director of the BARC after Homi Bhabha himself. From the year 2000 onwards, he has been leading the Atomic Energy Commission of India, and has been the secretary to the Department of Atomic Energy.

Dr. Anil Kakodkar has been playing a crucial part in demanding sovereignty for India's nuclear tests. He is known for being a strong advocate of India's self-reliance by employing thorium as a fuel for nuclear energy. He has published over 250 research papers, and is the recipient of the Padma Shri, Padma Bhushan, and Padma Vibhushan, awards.

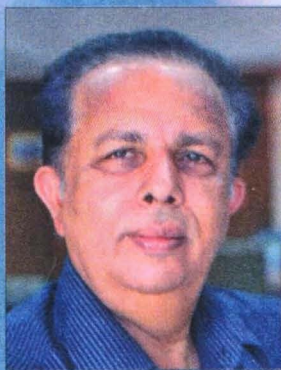




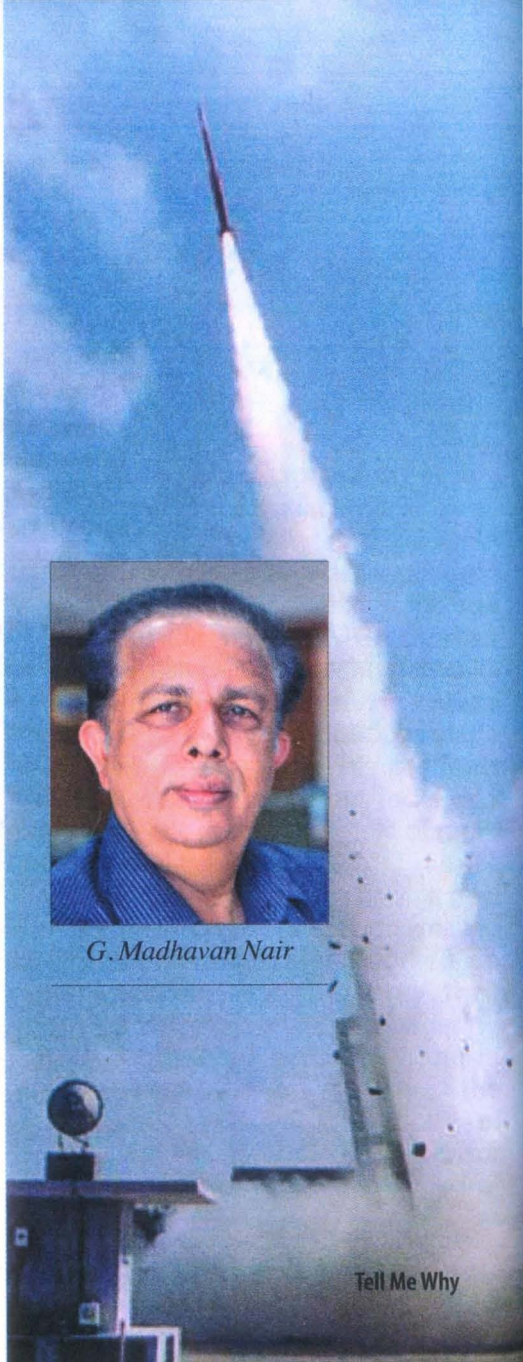


## Siva S. Banda

**Dr. Siva S. Banda is the director of the Control Science Center of Excellence, and senior scientist for Control Theory for the Air Vehicles Directorate at the United States Air Force Research Laboratory at Wright-Patterson Air Force Base. He performs and directs research and development activities at the AFRL Center of Excellence in Control Science, and is responsible for the transition of basic research results from control theory to the aerospace industry.**



*G. Madhavan Nair*

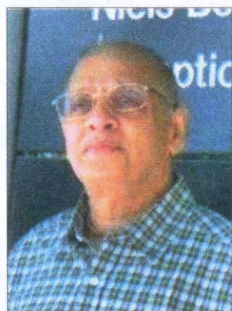




## Why is G. Madhavan Nair's contribution to the growth of ISRO important?

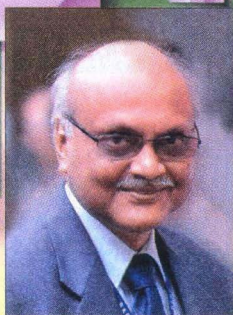
**D**r. G. Madhavan Nair joined the Thumba Equatorial Rocket Launching Station in 1967. He was responsible for charting the road map for the future development of ISRO's activities, especially in the launch vehicle area, targeting low cost access to space. Dr. Madhavan Nair has led the way towards the development of futuristic technologies to enhance the space systems capabilities as well as to reduce the cost of access to space. A major thrust area was in the exploration of outer space using the ASTROSAT and the Chandrayaan or moon missions. He has accomplished 25 successful missions during his tenure of six years as Chairman, ISRO and Secretary, DOS.

Dr. Madhavan Nair has played an important role in evolving application programmes such as tele-education and telemedicine for meeting the needs of society at large. In the international arena, Dr. Madhavan Nair has led the Indian delegations for bilateral cooperation and negotiations with many space agencies and countries, especially with France, Russia, and Israel. Dr. Madhavan Nair has received both the Padma Bhushan and Padma Vibhushan awards.



## Ravi Gomatam

**Ravi Gomatam is one of the pioneers in the field of consciousness studies. He has a distinguished background in both science and religion. He holds a master's degree in electronics engineering, and a Ph D. in foundations of quantum mechanics. He was the director of the Bhaktivedanta Institute and Institute of Semantic Information Sciences and Technology.**



## Ratan Kumar Sinha

**Dr. Ratan Kumar Sinha** took over as the chairman of the Atomic Energy Commission and secretary, Department of Atomic Energy in April 2012. The programmes that Dr. Sinha has been associated with include the advanced heavy water reactor, and the Indian high temperature reactor.

## Why is Jagadish Shukla famous?

**D**r. Jagadish Shukla was born in 1944 in a small village in Uttar Pradesh, India. After working at the Indian Institute of Tropical Meteorology in Pune, he received a Ph.D. from Benares Hindu University, and then left for the USA, where he received a Ph.D.



*Prem Chand  
Pandey*

## What do we know about Prem Chand Pandey?

**D**r. Prem Chand Pandey has done sterling work in the fields of satellite oceanography, remote sensing, atmospheric science, and climate change. In 1977, he joined the Space Applica-

in Meteorology from the Massachusetts Institute of Technology. He opted for a career in the atmospheric sciences in the USA. Dr. Shukla's contributions to the understanding of the predictability of weather and climate include the Asian monsoon dynamics, deforestation and desertification. He helped establish weather and climate research centres in India, and also established research institutions in Brazil, and the USA.

Dr. Shukla has been associated with the World Climate Research Programme since its inception, and founded the Center for Ocean-Land-Atmosphere Studies. He has established the Gandhi College in his village for the education of rural students, especially women.

tions Centre or SAC of ISRO, and became the founder head of the Oceanic Sciences Division/ Meteorology and Oceanography Group/ Remote Sensing Applications Area. He worked for the next twenty years at SAC. In the 1980s, he was also a research associate at the NASA - Jet Propulsion Laboratory, Pasadena, where he worked on the Upper Atmosphere Research Satellite, and SEASAT programmes. He was the founding director of the National Centre for Antarctic and Ocean Research, and also the K. Banerjee Centre of Ocean and Atmosphere Studies. Dr.

Prem Chand Pandey was visiting professor at IIT Kharagpur. At present he is a professor at IIT Bhubaneswar.





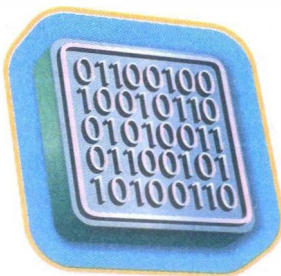
## Why is Vijay P. Bhatkar considered a pioneer in India's IT industry?

**D**r. Vijay P. Bhatkar is best known as the architect of India's first supercomputer, and as the founder executive director of C-DAC, India's national initiative in supercomputing. He is, without doubt, one of the most acclaimed IT leaders of India. He is best known as an architect of the PARAM series of supercomputers, GIST multilingual technology, and Education-To-Home, or ETH mission. Dr. Bhatkar is also widely recognized for his noteworthy contributions in bringing ICT to the masses through a series of path-breaking initiatives. He has authored and edited 12 books, and 80 research and technical papers.

For his contributions to IT in India, he was conferred with the Padma Shri award, and the Maharashtra Bhushan award, the highest recognition of the Government of Maharashtra. Dr. Bhatkar is a Fellow of the Computer Society of India, Member of the New York Academy of Sciences, and is active in several leading national and international professional societies and task forces, holding key positions in many of them.



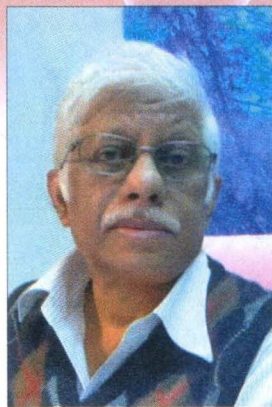
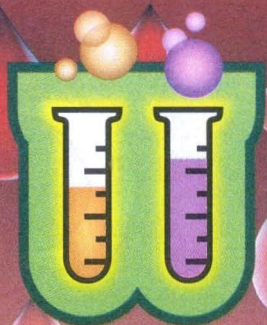
*Vijay P. Bhatkar*



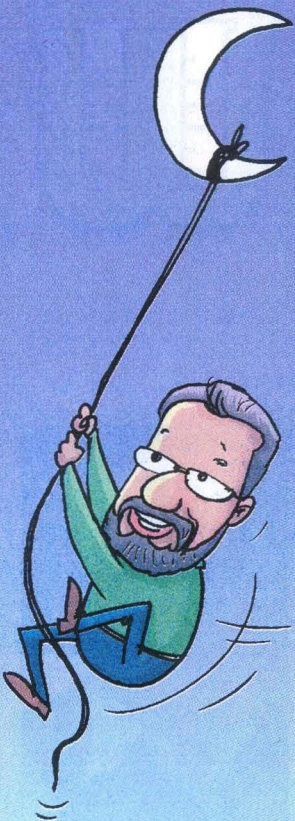
## What do we know about M.R.S. Rao?

**P**rof M.R.S. Rao graduated from the Department of Biochemistry, Indian Institute of Science Bangalore, and obtained his postdoctoral training from Baylor College of Medicine, USA, after which he returned to the Indian Institute of Science. He is a Fellow of all the science academies in India as well as the Academy of Sciences for the Developing World Trieste in Italy. He has been a member and chairman of several scientific advisory committees as well.

Prof. Rao is actively engaged in research on non-coding RNA in development and differentiation, cancer biology, and chromatin biology. He is also the team leader of the CSIR's NMITLI Network Project on cancer genomics, particularly on Glioblastoma. Prof. Rao has published more than 130 papers in international journals. He currently directs the Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore, and has received several recognitions including the Shanti Swarup Bhatnagar award and Padma Shri award.



*M.R.S. Rao*



## Why is K. Radhakrishnan an extraordinary person?

**D**r.K.Radhakrishnan, the current Chairman of Space Commission Secretary, Department of Space, Government of India and Chairman of ISRO, started his career as an avionics engineer in 1971 at ISRO's Vikram Sarabhai Space Centre, Trivandrum. He has held several decisive positions in ISRO. Currently, as chief of the country's space programme, he has been spearheading the ISRO saga forward. As the director of the Vikram Sarabhai Space Centre, he played a crucial role in the first Indian lunar mission - the Chandrayaan. His flair for leadership has been proved by the successful launch of Cartosat-2B, and four

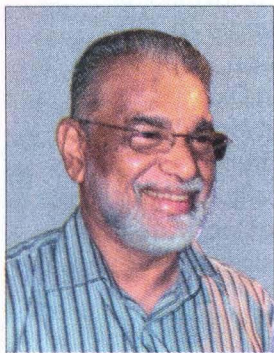
## Shivram Bhoje

**Dr. Shivram Bhoje is a distinguished nuclear scientist from India. He has worked in the field of fast breeder nuclear technology for forty years, and has been honoured with the Padma Shri award in 2003.**



co-passenger satellites by PSLV-C15 within just three months of the unsuccessful flight testing of the indigenous cryogenic stage in GSLV-D3, and the impetus given to the setting up of the Indian Institute of Space Science and Technology for human capital development.

Under his stewardship, four more successful launches of Polar Satellite Launch Vehicle PSLV were realised and 20 satellites (including Cartosat-2A, Indian Mini Satellite-1, RISAT-2, Oceansat-2, and two major foreign commercial satellites and 14 foreign Nano-satellites) were placed precisely into the desired orbits.



*K. Radhakrishnan*

During 2000-05, Dr. Radhakrishnan had a stint in the Ministry of Earth Sciences as the founder director of the Indian National Centre for Ocean Information Services. In addition, he was the first project director of the Indian National Tsunami Warning System.

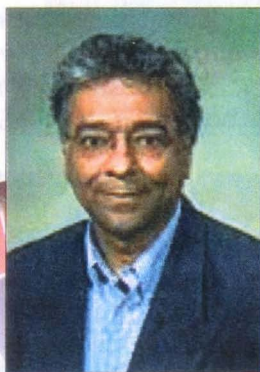


## **Arun Netravali**

**Arun Netravali, an Indian-American computer engineer, is well known for his contributions to the field of digital technology. He has been president of Bell Laboratories, and chief scientist for Lucent Technologies.**

## What do we know about Abhay Ashtekar?

**D**r. Abhay Ashtekar, is a world-renowned physicist and the leader of a worldwide effort to reconcile Einstein's Theory of Relativity with the principles of quantum mechanics. He is one of the founders of loop quantum gravity, and its subfield, loop quantum cosmology. He has had appointments in Oxford, Paris, and Syracuse, before settling in Pennsylvania. In 1992, Penn State University created the Center for Gravitational Physics and Geometry specifically for him. He has written a number of descriptions of loop quantum gravity that are accessible to non-physicists. At present, he is the Eberly Professor of Physics, and the Director of the Institute for Gravitational Physics and Geometry at Pennsylvania State University.



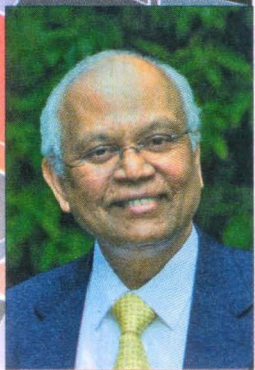
*Abhay Ashtekar*

## What are the contributions of Mashelkar?

**D**r. R.A. Mashelkar was the Director General of Council of Scientific and Industrial Research also known as CSIR. It is the largest chain of publicly funded industrial research and development institutions in the world, with thirty-seven laboratories, and about 20,000 employees.

After obtaining his Ph D. from Bombay University in 1969, Dr. Mashelkar occupied various academic positions in Europe and USA. He joined NCL as a scientist in 1976. He rose to the position of Head, Chemical Engineering Division in October 1978, and became the sixth director of NCL in 1989. Dr. Mashelkar's research interests are in the area of non-newtonian fluid mechanics, polymer reaction engineering, gel science, and polymer rheology. His work combines experiment and theory, and provides a framework for understanding many physical phenomena in complex fluids.

Dr. Mashelkar has won over 40 awards and medals. In August 1997, Business India named Dr. Mashelkar as being among the 50 path-breakers in post- Independent India. In 1998, Dr. Mashelkar won the JRD Tata Corporate Leadership Award, the first scientist to win it. The President of India honoured Dr. Mashelkar with Padmashri and with the Padmabhushan in recognition of his contribution to nation building.



*R.A. Mashelkar*



### Why is Arun Majumdar famous?

**A**run Majumdar was in the spotlight as President Barack Obama's nominee for the Undersecretary of Energy between November 30<sup>th</sup>, 2011, and May 15<sup>th</sup>, 2012. A materials scientist, engineer, and Indian Institute of Technology, Bombay graduate, he is a leading scientist in the fields of thermoelectric materials, heat and mass transfer, thermal management, and waste heat recovery.

Dr. Majumdar was the associate laboratory director for Energy and Environment at Lawrence Berkeley National Laboratory, and a professor of Mechanical Engineering and Materials Science and Engineering at the University of California, Berkeley. His highly distinguished research career includes the science and engineering of energy conversion, transport, and storage ranging from molecular and nanoscale level, to large energy systems. Dr. Majumdar helped shape several strategic initiatives in the areas of energy efficiency, renewable energy, and energy storage. Additionally, he has served as an advisor to startup companies and venture capital firms in the Silicon Valley.



*Arun Majumdar*

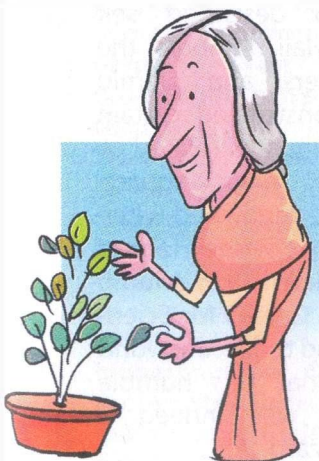


*Janaki Ammal*

## **Why is Janaki Ammal one of the most respected of Indian botanists?**

**J**anaki Ammal is a name that evokes respect among botanists for her work in the fields of cytogenetics and geography. She collected plants of medicinal and economic importance from the rainforests of Kerala, and is renowned for her research on sugar cane and the eggplant. Janaki Ammal did her higher studies and research abroad, but returned to India in 1951 to reorganize the Botanical Survey of India. She worked for the Government of India in different positions in the Central Botanical Laboratory at Allahabad, the Regional Research Laboratory in Jammu, and the Bhabha Atomic Research Centre at Trombay, before settling down in Madras in November 1970 as an Emeritus Scientist at the Centre for Advanced Study in Botany, University of Madras.

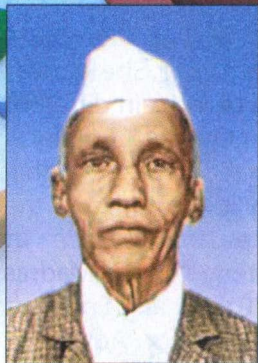
During her years abroad, Janaki Ammal did chromosome studies on a wide range of garden plants. She has been honoured with the Padma Shri award, and a national award of taxonomy in her name has been established. With her passion for plants, Janaki Ammal defined for herself her goals and purpose, and her mission in life. Having done that, she kept her mission above everything else, and was faithful to it all her life.



## Why was D.R. Kaprekar an amazing mathematician?

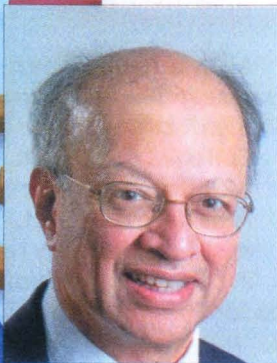
**D**.R. Kaprekar was an Indian mathematician who made a name for himself in mathematics despite having no formal training in the field. He was a school teacher who published extensively on topics like recurring decimals, magic squares, and integers with special properties. Kaprekar discovered a number of results in number theory, and described various properties of numbers. The Kaprekar constant and the Kaprekar numbers were named after him. Did you know that the number, 6174 is also known as the Kaprekar Constant?

Kaprekar also described self numbers or Devlali numbers, the Harshad numbers and Demlo numbers. He constructed certain types of magic squares related to the Copernicus magic square. Kaprekar became renowned when Martin Gardner wrote about Kaprekar in his March 1975 column of Mathematical Games for Scientific American-and today, the world acknowledges that this humble school teacher was indeed a mathematical wizard.



*D.R. Kaprekar*





*Ashok Gadgil*

## **Why is Ashok Gadgil is considered a successful scientist?**

**A**shok Gadgil is the director of the Energy and Environmental Technologies Division at Lawrence Berkeley National Laboratory, and professor of Civil and Environmental

Engineering at the University of California. He is best known for his work with two developing-world technologies. They are the 'UV Waterworks' - a simple, effective and inexpensive water disinfection system- and the Berkeley-Darfur Stove, which is a low-cost stove that saves fuel wood. He is also conducting experimental and modeling research in indoor airflow and pollutant transport. In recent years, he has worked on ways to inexpensively remove arsenic from Bangladesh's drinking water. It is his substantial experience in technical, economic, and policy research on energy efficiency and its implementation that has made him one of the most successful scientists of our time.

### **Drug Designer**

**Tej P. Singh, one of India's leading biophysicists, has played an active role in the development of researches on drug design in the fields of tuberculosis, inflammation, cancer, epilepsy, and arthritis in India. He has published more than 350 research papers, and has submitted the highest number of protein structures in India in the protein data bank.**

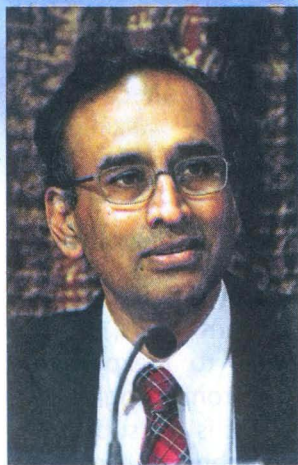


## Ajith Lalvani

**Ajith Lalvani is the most cited TB researcher in the world. He is Chair of Infectious Diseases, Imperial College London. Dr. Lalvani founded, and directs the Tuberculosis Research Unit, a leading multi-disciplinary research group in the world. His work forms the**

**basis of new guidelines for TB screening and prevention throughout the world.**

● *DevNath*



*Venkatraman  
Ramakrishnan*

## Why has Venkatraman Ramakrishnan made India proud?

**V**enkatraman Ramakrishnan, an Indian born, British structural biologist, was awarded the Nobel Prize for Chemistry along with Thomas A. Steitz and Ada Yonath in 2009, for his research into the atomic structure and function of cellular particles called ribosomes. Dr. Ramakrishnan holds a dual American and British citizenship. Although Dr. Ramakrishnan's initial academic background prepared him for a career in theoretical physics, his interests later shifted toward molecular biology. He conducted his postdoctoral research from 1978 to 1982 at





## Nagendra Kumar Singh

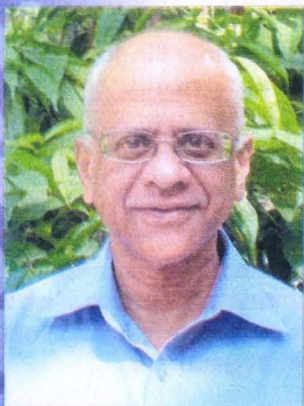
**Dr. Nagendra Kumar Singh, an eminent Indian agricultural scientist, is widely known for his research in the area of plant genomics and biotechnology. His contributions include the decoding of rice, tomato, and pigeon pea genomes, as well as the mapping of genes for salt tolerance and basmati quality traits in rice. He has also done a comparative analysis of rice and wheat genomes.**

Yale University in New Haven, Connecticut.

From 1983 to 1995, Dr. Ramakrishnan was a biophysicist at Brookhaven National Laboratory in New York. In 1999, he took a position in the Medical Research Council Laboratory of Molecular Biology at the University of Cambridge in England. The following year, he published a series of groundbreaking scientific papers. Dr. Ramakrishnan was elected a member of the U.S. National Academy of Sciences in 2004, and was elected a foreign member of the Indian National Science Academy in 2008. He is the recipient of many honours, including a knighthood, and the Padma Vibhushan.







*G.R. Desiraju*

**Why is Gautam Radhakrishna Desiraju well known in his field?**

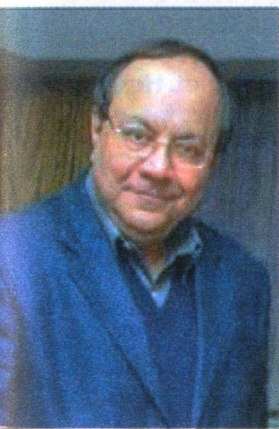
**G**autam Radhakrishna Desiraju is an Indian chemist who works at the School of Chemistry, University of Hyderabad. He has initiated and carried out research in crystal engineering, and has had a major impact on the development of this subject, which has grown vastly with nearly 200 independent research groups now worldwide. Desiraju is recognized as one of the founders of this subject, which lies at the intersection of organic chemistry, inorganic chemistry, crystallography, supramolecular chemistry, solid-state chemistry, and materials science. He, among others, has also been responsible in recent times for the acceptance of the theme of weak hydrogen bonding in structural and supramolecular chemistry. Desiraju's work is very highly cited, and is considered to have a major impact on modern chemistry. He has been recognized by a number of awards such as the Alexander von Humboldt Forschungspreis, and the TWAS award in chemistry.



## Gajendra Pal Singh Raghava

Gajendra Pal Singh Raghava has developed a number of web servers for application in computational biology, particularly in protein modeling. His work in this field has made him one of the most well known specialists in bio-informatics in India.

## Why is Samir K. Brahmachari an important figure on the scientific stage in India?



*Samir K.  
Brahmachari*

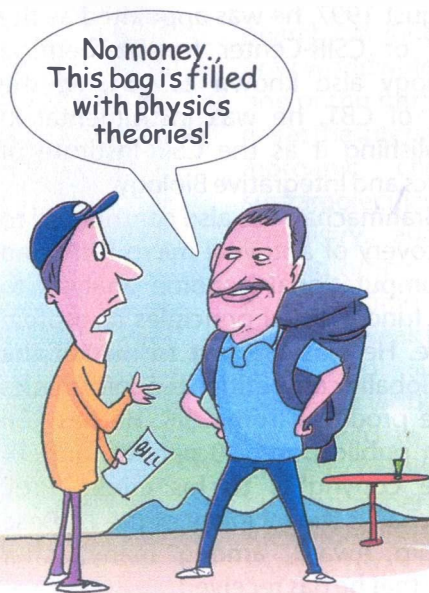
Samir K. Brahmachari is an Indian biophysicist whose core expertise is in structural and computational biology. On 11<sup>th</sup> August 1997, he was appointed as the director of CSIR-Center for Biochemical Technology also known as CBT. As the director of CBT, he was instrumental in re-establishing it as the CSIR-Institute of Genomics and Integrative Biology.

Prof. Brahmachari has also contributed to the discovery of anti-viral micro RNA, and used computational genome analysis to identify fundamental principles of protein structure. He was the first to market the novel, globally competitive bio-informatics software products from CSIR. He has 138 research publications, 10 patents, and 14 software copyrights to his credit. Prof. Brahmachari is the recipient of the J.C Bose Fellowship Award, among many other honours that he has received.

## Sandip Trivedi

**Prof. Sandip Trivedi, an Indian theoretical physicist, is well known for his contributions to the string theory. He works at the Tata Institute of Fundamental Research, Mumbai. Professor Trivedi's research forges important connections between superstring theory, cosmology and particle physics.**

● *Sneha Rao*



## Dipan Ghosh

**Prof. Dipan Ghosh, a theoretical physicist, is famed for his exact enumeration of the ground state of a Heisenberg anti ferro magnet. He is currently Professor Emeritus at IIT Bombay.**

## What are Sunil Mukhi's areas of research?

**D**r. Sunil Mukhi is an Indian theoretical physicist who earned a Ph.D. in theoretical physics in 1981 from the State University of New York at Stony Brook. He has worked at the Tata Institute of Fundamental Research in Mumbai, since 1984. In November, 2012 he joined

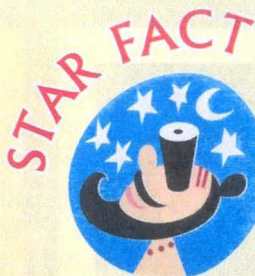




*Sunil Mukhi*

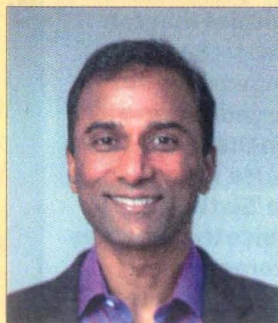
the Indian Institute of Science Education and Research, Pune. Dr. Mukhi has made significant contributions in the fields of string theory, quantum field theory, and particle physics.

Dr. Mukhi is a Fellow of the Indian Academy of Sciences, and the Indian National Science Academy. He is a recipient of the S.S. Bhatnagar Award for Physical Sciences, 1999, and the J.C. Bose Fellowship, 2008. He has been an editor of the Journal of High Energy Physics since its inception.



### EMAIL Man

**In 1978, VA Shiva Ayyadurai developed a computer programme, which replicated the features of the inter-office, inter-organizational paper mail system. He named his programme 'EMAIL'. However, there is now a lot of controversy over who actually invented e-mail.**





## Pranav Mistry

**Pranav Mistry, an Indian computer scientist, is passionate about integrating the digital informational experience with our real-world needs, and has several inventions to his credit. These include intelligent sticky notes, called Quickies that can be searched and can send reminders, and a pen that draws in 3D. He invented the 'Sixth Sense', a device that enables interactions between the real world and the world of data.**

## Why is Ashoke Sen considered a brilliant scientist?

**P**rof. Ashoke Sen, a theoretical physicist, has made a number of major original contributions to the subject of string theory. He studied at the prestigious Indian Institute of Technology, Kanpur, and got a doctorate from the State University of New York, Stony Brook. Professor Sen, now at the Harish-Chandra Research Institute

## Who developed Karmarkar's algorithm?

**N**arendra Krishna Karmarkar, a famous Indian mathematician, is renowned for developing Karmarkar's algorithm. An algorithm is a step-by-step solution to a problem. It is like a cooking recipe for mathematics. Karmarkar's algorithm helped to solve problems in linear programming in a novel way. He invented his famous algorithm and published the results while he



*Ashoke Sen*

in Allahabad, is famous, among other things, for his pioneering string-theoretic approach to black holes, and for his ideas about the beginning of the universe. He has authored, and co-authored, many important papers on string field theory. Of his nearly 200 research papers, as many as 47 papers have over 100 citations each. Prof. Sen was one of the winners of the first Fundamental Physics prize started by Russian billionaire Yuri Milner. He and eight other scientists got \$3 million each—double of what is given with the Nobel prize. He is also the recipient of the Padma Bhushan and Bhatnagar Awards, among many other awards.

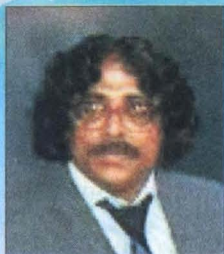
was working for Bell Laboratories in New Jersey.

Karmarkar received his B.Tech in Electrical Engineering from IIT Bombay, M.S. from the California Institute of Technology, and Ph.D. in computer science from the University of California, Berkeley. On his return to India, Karmarkar joined the Tata Institute of Fundamental Research, Mumbai. He is currently working on a new architecture for supercomputing. He is the recipient of many awards, and the Association for Computing Machinery awarded him the prestigious Paris Kanellakis Award in 2000.



*Narendra  
Krishna Karmarkar*





*Mrinal Thakur*

### **Why is Mrinal Thakur associated with the Nobel Prize?**

**D**r. Mrinal Thakur, a polymer expert, holds many patents on electrically conductive polymers. A former student of Vishwabharati University, Dr Thakur left for the US for further studies. He holds M.S. and Ph.D. degrees from Case Western Reserve University. He has been recommended by different institutions since 2002 for the Nobel Prize for Chemistry- but has proved to be unlucky so far. In fact, he claims that the 2000 Nobel Prize for chemistry to Alan J. Heeger, Alan MacDiarmid and Hideki Shirakawa, for the discovery and development of conductive polymers, was wrongly awarded for a scientific result he disproved in 1988.

### **Manindra Agrawal**

**Manindra Agrawal, professor at the department of computerscience and engineering and the Dean of Faculty Affairs at the Indian Institute of Technology, Kanpur, was the recipient of the first Infosys Prize for mathematics. He has also been honoured with the Bhatnagar award, and a Padma Shri. He has been active over the past ten years in the fields of decision theory, complexity, and the relation between the geometry of sets and their information content.**





*P. Balaram*

### What do we know about P. Balaram?

**D**r. P. Balaram, an Indian biochemist, is a professor of molecular biophysics, and currently the director of the Indian Institute of Science, Bangalore. He received his M.Sc. from IIT Kanpur, and Ph.D. in chemistry from Carnegie-Mellon, Pittsburgh, USA. His main research interests are in bio-organic chemistry and molecular biophysics. He is the author of over 400 research papers.

Dr. Balaram is a Fellow of the Indian Academy of Sciences, Indian National Science Academy, and the Third World Academy of Sciences, Trieste, Italy. He has received many awards and honours in recognition of his work, of which mention must be made of the Shanti Swarup Bhatnagar award, and the Padma Shri. Dr. Balaram has delivered a number of lectures and has served on the editorial boards of journals, both national and international. He has served on many committees of the Government of India, and is currently a member, Science Advisory Committee to the Union Cabinet, and Scientific Advisory Council to the Prime Minister, among others.



**Which Indian scientist is considered a pioneer in nanotechnology?**

**P**ulickel Ajayan, Professor in Engineering at Rice University, is a pioneer in the field of nanotechnology. His early education was in Kerala, India. During the past two decades, Prof. Ajayan has published more than 400 papers on various aspects of carbon nanostructures. In August 2007, he was in the news for creating an energy storage device on a piece of paper, called the paper battery. He is also interested in the development of various materials for environmental applications and, last year, this group developed a hybrid material capable of effectively removing contaminants from water.

His present research interests include nanocomposites, layered materials, 3D nanostructured materials, and smart material systems. Prof. Ajayan has received several awards. He is on the advisory editorial board of several leading journals, and sits on the boards of several nanotechnology companies.



*Pulickel Ajayan*





## Guinness Records

**Prof. Ajayan has two Guinness Book of World Records to his credit. The first is for creating the smallest brush, and second is for inventing the darkest material- a carpet of carbon nanotubes that reflects only 0.045 percent of light.**

## Why is Anil Bharadwaj a space scientist par excellence?

**D**r. Anil Bharadwaj is a planetary and space scientist working at the Vikram Sarabhai Space Centre, ISRO, Trivandrum, India. Dr. Bharadwaj initiated the research in planetary science at SPL or Space Physics Laboratory at VSSC, and has contributed to the development of planetary science activities and planning of planetary missions in India. He has been the principal investigator on many observation programs. Dr. Bhardwaj has written a Chapter for Encyclopedia of the Solar System, edited five books and has over 90 publications. He also collaborates with several research projects being conducted in many research institutes in USA, Europe, and Asia. He holds many awards, including the Bhatnagar Award.



NEXT ISSUE

# PLANETS

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**What are George Joseph's contributions to the Indian space programme?**



*George Joseph*

**D**r. George Joseph is considered the pioneer of satellite based imaging sensors in India. In 1973, Dr. Joseph joined the Space Applications centres at Ahmedabad. He has been the guiding force in the design and development of all the Earth observation cameras on board Indian remote sensing satellites and INSAT. A novel detector system designed by him was flown on the first Indian satellite 'Aryabhata' to detect solar neutrons. Dr. Joseph was awarded the 'Padma Bhushan' by the Government of India in 1999.

## Sangamagrama Madhava

The Kerala school of Mathematics was founded in the 14<sup>th</sup> century by Sangamagrama Madhava, sometimes called the greatest mathematician-astronomer of medieval India. Although almost all of Madhava's original work is lost, he is referred to in the work of later mathematicians as the source for several infinite series expansions, including the sine, cosine, and tangent.



## Rajesh Gopakumar

Rajesh Gopakumar is a theoretical physicist at the Harish-Chandra Research Institute in Allahabad. He has been primarily interested in understanding better the relation between string theories and quantum field theories.



## M. Radhakrishna Pillai

Dr. M. Radhakrishna Pillai, is the Director of the Rajiv Gandhi Centre for Biotechnology at Thiruvananthapuram. He has a PhD in tumour immunology and a post-doctoral fellowship in molecular biology and immunopharmacology from the University of Arizona. For his outstanding contributions to cancer research and medical biotechnology, he was honoured with National Bioscience Career Award.

● K.P.S.





# WHO'S WHO?

Here's a contest in which our readers have to identify four famous Indian scientists, from the three clues given for each of them. All you need to do is send us an email naming each scientist with the proper number.

You are also welcome to send your answer by post. Five winners will be awarded prizes. In case there are more than five correct entries, the winners will be chosen by lot.

Last Date to receive entries:

**June 25<sup>th</sup>**

Our e mail address:

**childrensdivision@mmp.in**

Please enter

**TMW- GK CONTEST -1**

in the subject line of your e mail.

If you are sending your entry by post, superscribe this on your envelope.

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**1**

1. This scientist pioneered research on radio waves and microwave optics.
2. This scientist is known for experiments demonstrating sensitivity and growth of plants.
3. The British Government knighted this scientist in 1917.



**FIVE LUCKY WINNERS  
WILL GET THE AMAZING  
SCIENCE KIT**

## POTATO CLOCK



**Make a clock work using vegetable power**

2

1. This scientist was a self-taught mathematician.
2. This scientist sent remarkable theorems to the great mathematician Godfrey Hardy.
3. The number 1729 is known by this scientist's name.



3

1. This scientist worked under H.J. Bhabha on India's nuclear programme.
2. This scientist directed the team of scientists who supervised the nuclear test 'Smiling Buddha'.
3. This scientist was Union Minister of State for Defence in 1990.



4

1. This scientist is often called the Father of the Indian Space Programme.
2. ISRO is one of this scientist's great achievements.
3. This scientist headed the launch of the first Indian satellite Aryabhata.





# I Wonder Why?

## Question of the Month

Send us your questions  
E mail: [childrensdivision@mmp.in](mailto:childrensdivision@mmp.in)

### Why are rain clouds black?

Clouds are formed of tiny water droplets and ice crystals that float in the air. Generally, clouds appear white in colour because of the scattering of sunlight. As you know, sunlight consists of the seven colours of a rainbow. When light passes through clouds, all the seven colours are scattered by the water droplets and ice particles and together they produce a white appearance.

Rain clouds, however, are densely packed with water droplets, ice and snow particles. So, light cannot penetrate them. Thus we do not see the rays from the sun and this results in a dark effect.

If we look from an aircraft flying at a high altitude, these dark clouds will look white. This is due to the reflection of light falling on them. That means the same clouds appear both dark and white at the same time!

● **Alwin George**

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